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Responsibilities to Address O and M Considerations in the Construction Grants Process: Participant Handbook

Texas A and M Univ.
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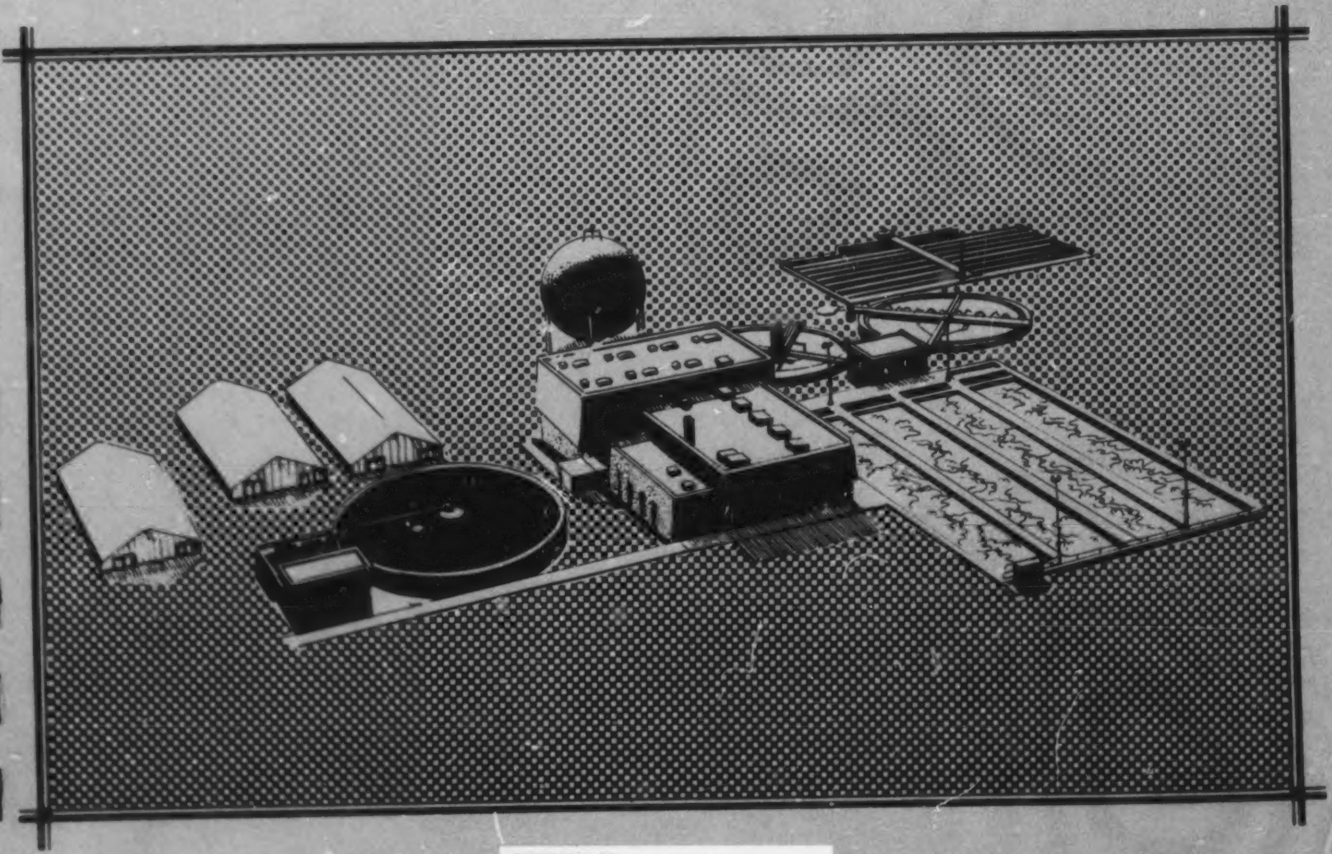

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Designed for a 1 day workshop on O & M Considerations in the construction grants process, this handbook outlines procedures in the USEPA Construction Grants Program which should be taken by local officials to assure that operation and maintenance are given full attention throughout the Construction Grants Process. Individual chapters deal with: Grantee Responsibilities - What to Look For, Operational Considerations, Plan of Operation, Elements of a Good O & M Manual, Start-Up Services and Inspections.

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PARTICIPANT HANDBOOK

Prepared for:

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Cincinnati, Ohio 45268

Under Training Grant No. T-901-051-010

by

Water and Wastewater Training Division

In cooperation with

Vocational Industrial Teacher Education Division

Texas Engineering Extension Service
The Texas A&M University System
College Station, Texas 77843

DISCLAIMER

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FOREWORD

This handbook is designed as a supplement to a one-day workshop titled "Responsibility to Address O&M Considerations in the Construction Grants Process."

It is to be used by the participant:

1. To facilitate understanding of materials covered in the workshop
2. As a handbook for the workshop
3. As a postcourse reference

The information provided in this handbook is of primary importance to Step 1 grantees and their representatives involved in meeting the O&M requirements of the construction grants process.

In addition to this manual, the associated instructor's manual entitled "Responsibilities to Address O&M Considerations in the Construction Grants Process" (EPA-430/1-80-010, May 1981), handouts, and visual materials (referenced in the instructor's manual) are also part of the course package.

INTRODUCTION

The primary target audience for this one-day orientation workshop will be the appropriate representatives of municipalities who will receive or have received a Step 1 grant under Title II of the Clean Water Act. These representatives may include municipal officials such as city managers, plant superintendents, directors of public works, etc., as well as their consultants. Other possible attendees of this workshop may include similar representatives of municipalities which have Step 2 or Step 3 grants, Section 201 advisory groups, other citizen groups, and state agency officials.

Over the past 25 years, nearly 20 billion dollars have been spent through federally funded construction grants programs to build new wastewater treatment facilities. Strong evidence exists which shows that one-third to one-half of those newly constructed facilities are not operating in accordance with their original design objectives. This continuing trend of poor performance is of great concern and must be dealt with effectively if the wastewater treatment facility construction grant program is to meet its goal of controlling point source pollution. Although there are a variety of factors that contribute to this problem, it is recognized that certain actions can be taken through the grants program that will significantly improve the performance capabilities of future wastewater treatment facilities.

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UNIT ONE
WORKSHOP INTRODUCTION

OUTLINE

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OBJECTIVES

Following the Unit One presentation, the participant will be able to:

1. Discuss the objectives of the workshop
2. Identify O&M requirements as defined by:
    a. Regulations
    b. Guidelines
    c. Program requirements memoranda
3. Discuss the state delegation responsibilities as they relate to O&M

BACKGROUND

The Water Pollution Control Act (PL 84-660) was passed by Congress in 1956 and amended in 1972 (PL 92-500). In 1977 the Clean Water Act (PL 95-217) was passed. These laws provide for extensive involvement and support by the federal government in local wastewater treatment systems. The Environmental Protection Agency (EPA) has the responsibility of implementing these laws.

Over the past 25 years about 20 billion dollars in federally funded construction grants programs have been spent to build new wastewater treatment facilities. It is estimated that nearly 50 percent of these facilities are not meeting their original design objectives. This continuing trend of poor performance must be corrected if point source pollution is to be controlled.

WORKSHOP OBJECTIVES

This workshop is designed to motivate Step 1 grantees to address operational requirements throughout all the steps of the wastewater treatment facility construction grants process.

The objectives of this workshop are:

1. To emphasize the importance of considering O&M in each of the three steps of the construction grants process
2. To inform Step 1 grantees of the O&M requirements of the construction grants process
3. To inform Step 1 grantees of their responsibilities for compliance with the O&M requirements of the construction grants process.

O&M REQUIREMENTS OVERVIEW

Proper operation and maintenance of federally funded facilities is a longstanding program requirement which can be found in the statutes, regulations, guidelines, and program requirements memoranda.

Section 204(a)(4) of Public Law 92-500, the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977, states that no grant shall be awarded unless the applicant has made provisions for operation and maintenance of such works. The law also requires employment of trained operators to ensure proper operation and maintenance of the treatment works. This must be carried out in accordance with a state approved plan of operation. Therefore, both the state and grantee are charged by law to ensure proper operation and maintenance of the wastewater treatment facility.

Other operation and maintenance program requirements will be found in the Code of Federal Regulations (CFR), Title 40, Protection of the Environment, Chapter 1 Environmental Protection Agency, Part 35 - State and Local Assistance, Subpart E Grants for Construction of Treatment Works, Wednesday, September 27, 1978, Part 33. As in the law, the 40 CFR's require the grantee to operate and maintain the treatment works properly and efficiently. Other O&M program requirements include the development of an operation and maintenance manual, emergency readiness, operational reports, proper and efficient operation and maintenance of both treatment works and sewer collection systems, adequate O&M budgeting, and laboratory testing facilities. The grantee, by accepting the grant, agrees to fulfill all of the O&M program requirements. Failure to do so may cause the grant to be revoked. In addition the grantee may be liable for federal funds spent. The states also have a responsibility toward proper and efficient operation and maintenance of treatment works. The states are responsible for the postconstruction evaluation program of the treatment works. Without assurance of this evaluation, no grant may be awarded. Both the states and the grantee are charged with the proper and efficient operation and maintenance of wastewater treatment works. The various sections of 40 CFR, Part 35, Subpart E will be discussed in greater detail later in the course.

To ensure that proper O&M procedures will be followed, guidelines have been developed. The federal guidelines are designed as a helpful tool for those agencies involved in the construction grants program. They provide technical information and instructions for a successful grants program. Most of the guidelines make some mention of operation and maintenance. However, there are specific guidelines

O&M
GUIDELINES

designed for operation and maintenance. These stress reliability, operability, flexibility, and maintainability. They also address inspection, staffing and training, adequate laboratory control and records, safety, maintenance management programs, and financial responsibility. As the course progresses, these guidelines will be discussed in greater detail. Guidelines should be updated as new and proven technical data is developed.

To assure national uniformity and to provide policy direction in the construction grants program, EPA has issued numerous program requirements memoranda (PRM). These are designed to inform construction grants program personnel of policy direction in integrating the requirements of the program.

For the purpose of operation and maintenance, the focus should be on PRM 77-2, Grant Eligibility of Start-up Services, and PRM 77-3, Plan of Operation for Municipal Wastewater Facilities; PRM 77-2 and 77-3, as well as all PRM's, are available from the regional offices of USEPA, for those who are on the priority list and plan to participate in the construction grants process. These provide information on grant eligibility of start-up services and a plan of operation. The purpose of these PRM's is to assure that the municipal treatment works will achieve operational objectives quickly and effectively. The plan of operation should identify specific actions and completion dates of such actions. Start-up services should help achieve operational efficiency as soon as possible. From time to time, PRM's may be updated or replaced.

In conclusion, any individual or agency involved in the construction grants process should be aware of the O&M requirements as defined by the statutes, regulations, guidelines, and PRM's. These requirements should be updated as new technical data and on-the-job experience is acquired. Changes should be made in the construction grants process which place more emphasis on operation and maintenance from the beginning.

STATE DELEGATION

Section 205(g) of PL 92-500 as amended authorizes the Administrator of USEPA to delegate the authority and responsibility for administrating the construction grants program to the various states. Those states which have accepted delegation are responsible for ensuring that all program requirements are met. This responsibility includes (if delegation is accepted) monitering and approving the following:

1. O&M Manuals
2. Start-up Services
3. Plan of Operation
4. Plans and Specifications (for operability)
5. All other O&M requirements as outlined in PL 92-500, 40 CFR Part 35; and Program Requirement Memorandum
6. Any other item that is included in the agreement between the state and USEPA.

EPA
STATE DELEGATION
STATE

UNIT TWO

GRANTEE RESPONSIBILITIES: WHAT TO LOOK FOR

OUTLINE

I. AN OPERABLE FACILITY: THE PROCESS INVOLVED 2- 2
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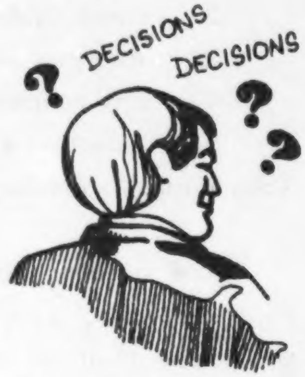
OBJECTIVES

Following the Unit Two presentation, the participant will be able to:

1. Discuss the process involved for constructing an operable facility
2. Discuss the sources and meaning of the NPDES criteria
3. State the qualifications for a consulting engineer
4. Determine the need for a working relationship between consultant and grantee
5. Explain the importance of conducting the preliminary investigation correctly

AN OPERABLE FACILITY: THE PROCESS INVOLVED



The grant applicant makes several critical decisions prior to and during a Step 1 grant application. Briefly, these steps are as follows:

1. A representative is selected to act for the applicant
2. A preapplication conference is attended by representatives of state and/or EPA; this conference may result in:
    a. The examination of alternatives and initial direction of the facility plan
    b. Selection of a consulting engineer based upon:
        (1) Minimum qualifications, duties, and responsibilities
        (2) Review of other facilities designed by consultant
        (3) Discussion of abilities of consultant with past clients
        (4) Examination of past projects for:
            (a) cost overruns
            (b) change orders
            (c) completion times
3. The engineer is usually selected to develop the required plan of study before the grant application is made.
4. The plan of study is developed and contains:
    a. A description of the proposed planning area (including a map)
    b. Identification of the political entity or entities that will conduct the planning
    c. A statement of the nature and scope of the proposed Step 1 project, including a public participation program and a schedule for the completion of the specified task
    d. An itemized description of estimated costs for planning the project
    e. Any significant public comments

Upon completion and approval of the plan of study, the grant applicant will submit a step 1 application. When the application is approved, the consultant starts the facility plan with the following steps:

1. Assessment of the current situation
2. Identification of alternatives
3. Analysis of cost-effectiveness
4. Environmental assessment/environmental impact statement
5. Selection of recommended alternatives

(See Table 1: Major Facilities Planning Decisions)

The decisions made by the grantee (i.e., selection of engineers, grantee representative, plan of study, facility plan, etc.) will greatly influence the development of an operable facility. The impact of these decisions on the costs of construction and operation and maintenance cannot be over emphasized. Decisions based upon sound engineering and factual data will lead to a facility that can be operated and maintained.

TABLE 1

MAJOR FACILITIES PLANNING DECISIONS

DECISION POINT	ISSUES	QUESTIONS
Assess the Current Situation:	a) Gather information on planning area: institutions population environment water quality other environmental conditions b) Gather data on: existing wastewater flows existing treatment systems infiltration/inflow analysis performance of existing systems	What are the current water quality problems? Are the existing facilities adequate? Will improved O&M of the existing facility eliminate or reduce the need for new construction? What unique resources does the community have that are worth protecting?
Assess the Future Situations:	a) Land use b) Demographic and economic projections c) Future flow and wasteloads d) Future environment without treatment project	How much growth is projected to occur? Are projections consistent with community goals/land-use plans? Are wastewater flow projections reasonable? Is a new treatment facility necessary to preserve the environmental quality of the community?
Identify Alternatives:	a) Rehabilitation of existing facility b) Improved capability and performance of existing plant through improved O&M c) Biological or physical/chemical treatment and discharge to receiving water d) Reuse/recycling systems e) Land Application systems	Is a full range of alternatives being considered including smaller scale, low technology options as well as centralized high technology ones? Is land treatment being seriously considered? Are there opportunities to recycle or reuse treated wastewater? How much treatment capacity is required?

TABLE 1 (continued)

DECISION POINT	ISSUES	QUESTIONS
Identify Alternatives:	f) Revenue generating applications g) Onsite and nonconventional systems h) Sludge and residual disposal	How much will O&M of each alternative cost the community? How much will O&M of each alternative cost each individual user?
Cost-Effectiveness:	a) Establish present worth of alternatives (monetary value of capital costs plus O&M costs over life of project): 1) service area 2) service life 3) staging construction b) Develop water conservation program c) Make institutional arrangements for implementation d) Conduct environmental impact assessment for each alternative e) Conduct recreational use assessment for each alternative f) Conduct energy consumption assessment	What sewage treatment alternative has the least monetary cost (including O&M costs and replacement costs) without overriding environmental and social considerations?
Environmental Impact Statement (EIS):	a) Gather additional information on primary and secondary environmental impacts b) Prepare draft impact statement and seek public and governmental review of draft EIS	Are the environmental impacts identified in the environmental assessment significant enough to warrant a full-scale EIS?

TABLE 1 (continued)

DECISION POINT	ISSUES
Select Alternative:	a) Develop measures to mitigate primary and secondary environmental impacts b) Select site c) Select plan that provides best possible treatment with least O&M cost and environmental impact

NPDES CRITERIA ATTAINMENT: EFFLUENT LIMITATION

The Federal Water Pollution Control Act Amendments of 1972 established the objective of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. This objective has remained unchanged in the 1977 amendments to the Act, commonly referred to as the Clean Water Act of 1977. To achieve this end, the Act sets forth a series of goals, including the goal of eliminating the discharge of pollutants into navigable waters by 1985. PL 92-500, Title IV Permits and License 401 through 405, is the mechanism for reducing the discharge of pollutants. The principal section for implementation of the National Pollutant Discharge Elimination System (NPDES) is established by Section 402 of the Act. In addition to this, Title 3 Standards and Enforcements sets forth the means to determine and enforce effluent limitations. Additional information on NPDES can be found in the Environmental Protection Agency Regulations on Criteria and Standards for the National Pollutant Discharge Elimination System 40 CFR Part 125, Criteria and Standards for National Pollution Discharge Elimination System.

The National Pollution Discharge Elimination System (NPDES) established by Section 402 of PL 92-500 is applicable to all municipal and industrial discharges where 303e (basin plans), 208 (areawide waste treatment management plans), and 201 (facility plans) of PL 92-500 have been established. The permit will require compliance with such plans. In existing sewage facilities, which will not achieve water quality standards because of present or future inadequate treatment, the NPDES permit may require the sewage facilities owner to apply for a construction grant.

NPDES permits have been issued to approximately 55,000 municipal and industrial point sources. Permits contain four primary elements: (1) final effluent limitations reflecting statutorily required treatment levels; (2) interim effluent limitations until the attainment of final effluent limitations; (3) construction schedules for the achievement of final effluent limitations; and (4) reporting requirements relating to compliance with effluent limitations established for each parameter limited in the permit for both interim or final effluent limitations and compliance with construction schedules.

Compliance with these effluent limitations and self-monitoring requirements of NPDES permits is assessed by the regulatory agency through a combined program of self-monitoring data review and facility inspections.

The National Pollutant Discharge Elimination System (NPDES) permits contain specific and legally enforceable effluent limitations and self-monitoring requirements for flow measurement and sampling. The sampling frequency, the sample type (grab or composite), the parameters to be monitored, the parameter limitations, the analytical methods, and the reporting frequency are determined by the permitting agency. Self-monitoring requirements must be such as to enable reasonable assessment of the discharger's performance relative to permit effluent limitations and the potential impact on the environment. Such factors as flow and concentration variability, treatment methodology, relative amounts of cooling and process wastewater, and receiving water quality are considered in establishing the self-monitoring requirements.

Historically, the major focus of final effluent limits contained in NPDES permits has been the control of conventional pollutants such as BOD, pH, fecal coliform, etc. At the time of the first round permitting, these pollutants were considered the parameters which most urgently needed controls.

In second round permitting, emphasis will be shifting from the conventional pollutants to the control of toxic pollutants. This shift is the next logical step in water pollution control as the potential for environmental harm from conventional pollutants decreases due to compliance with effluent and water quality standards.

The grantee's effluent limitations may be derived from:

1. The discharge permit in the case of existing discharge; or
2. The limitation set by the state for the segment of the receiving waters into which the effluent is discharged (streams classified as water quality limited); or
3. A minimum standard of discharge that is defined as the discharge level that can be expected from a well-operated secondary treatment facility (for streams classified as effluent limited).

The treatment facility alternative must be able to meet the effluent limitation set in its NPDES permit.

GRANTEE-CONSULTANT RELATIONSHIP

A Step 1 grant may only be awarded to an applicant that has the capability of constructing and/or managing the facility. It is possible for this applicant to have the resources to plan, design, and construct a wastewater treatment facility. Force account work (where the applicant does part of the work involved in the project) is allowable in Steps 1 & 2 ($10,000 or less) and Step 3 ($25,000 or less)and sewer rehabilitation ($25,000 or less). The grantee must demonstrate that it has the resources to do the work and can accomplish it more economically than a contractor or that an emergency dictates its use. However, the grantee may contract with a consulting engineer to plan, design, and construct the treatment plant.

The vast majority of engineers who plan and design wastewater treatment facilities are competent people; however, their technical expertise for a particular project will be affected by their education, experiences, and interests.

Selection of an engineering firm may be the most important step the applicant takes in the construction grants process. The engineering firm that is selected usually stays with the project throughout all three steps. The applicant should advertise its need for a consulting engineer and should thoroughly review and compare all of the engineers' proposals. If possible, the applicant should evaluate the wastewater facility plans developed by the engineering firm for other communities with problems similar to the applicant's.

When selecting an engineering firm, the grantee should look for the following:

1. Specialized experience and technical competence particularly in process control
2. Past records and performance on fullfilling contractual obligations
3. Capacity to perform the work required within time limitations (the firm's current workload must be considered)

4. Familiarity with the types of problems applicable to the project
5. Avoidance of conflict of interests
6. Philosophy on community development (which may conflict with the applicant's philosophy)
7. Who within the A/E firm will be doing the work
8. Previous clients of the A/E firm
9. Performance record of plants that meet NPDES effluent limitations
10. Performance record of plants that are operable and maintainable

The grantee must carefully weigh these factors prior to selecting its consulting engineer.

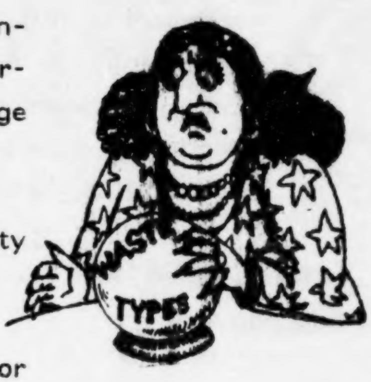
The consultant selected may be making many important political decisions in planning, designing, and overseeing construction of the wastewater treatment facility.

The engineer's role in the facility's plan depends upon the contract which is negotiated by the grantee and engineer. Usually the consultant will be responsible for producing a 201 facilities plan document that complies with all EPA and state requirements. The degree of involvement of the applicant in the Step 1 planning process will be determined by the degree of responsibility it retains (i.e., participation in the planning process, review of the plan as it develops, etc.).

The applicant must develop and maintain a good working relationship with its consultant. The applicant should retain control of overall management decisions. The applicant should not blindly accept the consultant's recommendations. The applicant is responsible for the project and its performance.

PRELIMINARY INVESTIGATION: WORK DONE WELL

Characterization of Wastes



Prior to developing a facility plan, the consulting engineer must determine the waste characteristics. The engineer should determine first if sewage is:

1. Domestic
2. Industrial (which may require treatability studies)
3. Storm
4. Combination of any of the first three, or
5. If infiltration/inflow (I/I) is a problem

The source of the sewage greatly affects the design of the facility (i.e., pretreatment for industrial waste, holding tanks for storm flows, etc.). Some sources (e.g., infiltration and inflow) may require rehabilitation of the sewer system to reduce or eliminate the I/I.

After the source or sources have been determined, the characteristics of each source must be identified. The five-day biochemical oxygen demand test (for strength) must be administered and the total suspended solids must be determined. In addition, characteristics such as chemicals, toxins, greases, acidity, alkalinity, etc., should be determined.

The flow (amount of sewage) is then determined. This is usually expressed in million gallons per day. The consultant should determine the:

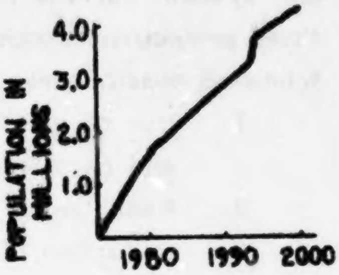
1. Peak flow
2. Average flow
    a. Daily
    b. Hourly
3. Minimum flow
4. Seasonal variations

Note: Organic load must be determined under each of the four above

After determining the present flows and characteristics of the present waste, the consultant must determine the future flows and loads based upon growth projections.

Growth Projection

Based upon the design period (i.e., life of facility) the consultant must determine the growth projection for the project area. This projection for the most part is based upon the U.S. Department of Commerce Bureau of Economic Analysis (BEA) population projections which were developed in 1977. The consultant may use the state's projections (if it was prepared before June 1978) if these projections for the year 2000 do not exceed BEA's projection by five percent. The consultant must justify to the regional administrator/state reviewer the population projection that was used to predict future population.



In determining future flows and loads, the consultant must also consider the possibility of future industrial and commercial expansion. The consultant must take the existing industrial and commercial flows and loads and add them to the projected flows and loads. The consultant can then determine the allowable amount for future industrial flow. This is usually based upon a percentage of design flow or industrial flow, whichever is less.

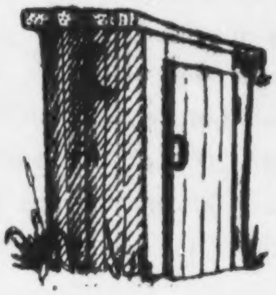
The design engineer often utilizes these growth projections when calculating the total annual wastewater flows. These flows are based on future population, existing population, per capita use, water conservation programs, current industry, and allowance for unanticipated industrial growth. From this data, the engineer must calculate average daily base flow (ADBF).

Present System Evaluation and Alternative Treatment Recommendations

After the characteristics of the waste and the anticipated flows have been determined and documented, and the effluent limitations have been obtained, the consultant is ready to determine the best solution to the pollution problem.

The characteristics of the sewage, the flow, the level of treatment needed, sludge handling, the effluent limitation, the water quality standards, operation and maintenance, and the policy of cost-effectiveness will limit the alternatives available to the grantee. The consultant must evaluate the present system and the alternative treatment systems based on all of the limitations previously mentioned. In addition, the consultant must investigate the following possibilities:

1. Use of existing facilities, upgrading O&M to meet permit limitation, and expansion
2. Reduction of I/I
3. Reduction of industrial sewage
4. Reduction of water use (by citizens)
5. Wastewater treatment alternatives:
    a. Physical treatment
    b. Biological treatment
    c. Chemical treatment
6. Land treatment

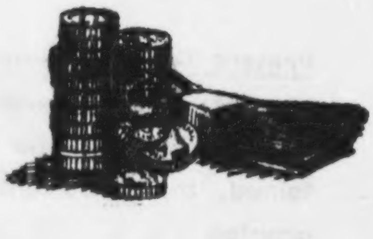


After the investigation is completed and the alternatives are evaluated, the alternative is selected that is the most cost-effective and has the least environmental impact. This alternative describes the project for which Step 2 detailed design and Step 3 construction grants may be requested.

By ensuring that the consultant has conducted the preliminary investigation properly, the grantee should be able to construct an operable facility.

User Charge: Will It Be Adequate?

Seventy-five percent of the planning, designing, and construction funds for the eligible portion of the wastewater treatment facilities come from the federal government. Additional funding may come from the state. The applicant must obtain the remaining funding (up to twenty-five percent if no state aid is given) from local funds. In addition, the applicant must fund the operation and maintenance cost of the



system after construction. The future cost of O&M may at first seem remote; however, the applicant must plan early for this cost.

The cost of operating and maintaining a wastewater treatment facility over its lifetime is far greater than the initial capital costs (construction costs). Monies must be collected and budgeted for O&M. The applicant must develop an approvable user charge system (40 CFR 35.929 to 35.929-3, Requirements for User Charge System). In addition to funding O&M, the user charge should allow for a sinking fund for equipment replacement. The grantee must realize that the user charge system must make the wastewater treatment facility self-supporting.

This is a system of user charges which assures that each user of the wastewater treatment facility pays its proportional share of the cost of O&M, including equipment replacement, during the life of the facility. These charges should be designed to provide an incentive to the user to reduce the wastewater flow and load and to promote O&M self-sufficiency.

The user charge system can be based upon actual use or ad valorem taxes. Regardless of the method used, the system must ensure that each user class pays its proportionate share of the operation and maintenance cost. When developing a user charge system the grantee must consult 40 CFR 35.939 through 40 CFR 35.939-3 (Requirements for User Charge System).

USER CHARGE SYSTEMS

A user charge is a charge levied on users of a treatment works, or that portion of the ad valorem taxes paid by a user for the user's proportional share of the operation and maintenance cost (including replacement). The grantee must have submitted a schedule for the development of a user charge system during Step 2. During Step 3, the grantee must begin to develop the user charge system. The system must meet the objective of distributing O&M costs among all users in proportion to their waste load. The user charge shall be based upon volume, flow rates, and strength of the wastes of all users. The costs of O&M must be equitable to each user or class of users. The user charge system should bring about operational self-sufficiency.

Appendix B of the EPA regulations (40 CFR 35) provide three model user charge systems which are given below.

(1) Model No. 1 - If the treatment works are primarily flow dependent or if the BOD, suspended solids, and other pollutant concentrations discharged by all users are approximately equal, then user charges can be developed on a volume basis in accordance with the model below:

$$Cu = \frac{Ct}{Vt} (Vu)$$

(2) Model No. 2 - When BOD, suspended solids, or other pollutant concentrations from a user exceed the range of concentration of these pollutants in normal domestic sewage, a surcharge added to a base charge, calculated by means of Model No. 1, can be levied. The surcharge can be computed by the model below:

$$Cs = [Bc (B) + Sc (S) + Pc (P)] Vu$$

(3) Model No. 3 - This model is commonly called the "quantity/quality formula":

$$Cu = Vc\ Vu + Bc\ Bu + Sc\ Su + Pc\ Pu$$

B = Concentration of BOD from a user above a base level

Bc = O&M cost for treatment of a unit of BOD

Bu = Total BOD contribution from a user per unit of time

Cu = A user's charge for O&M per unit of time

Cs = A surcharge for wastewaters of excessive strength

Ct = Total operation and maintenance (O&M) costs per unit of time

P = Concentration of any pollutants from a user above base level

Pc = O&M cost for treatment of a unit of any pollutant

Pu = Total contribution of any pollutant from a user per unit of time

Pt = Total contribution of any pollutant from all users per unit of time

S = Concentration of SS from a user above a base level

Sc = O&M cost for treatment of a unit of suspended solids

Su = Total suspended solids contribution from a user per unit of time

Vc = O&M cost for transportation and treatment of a unit of wastewater volume

Vu = Volume contribution from a user per unit of time

Vt = Total volume contribution from all users per unit of time

ONSITE LOCALLY CONTROLLED INSPECTIONS

Title 40, Chapter 1, Part 35, Subpart E, Grants for Construction of Treatment Works, Paragraph 40, CFR 35.935-8, Supervision requires:

> "In the case of any project involving Step 3, the grantee will provide and maintain competent and adequate engineering supervision and inspection of the project to ensure that the construction conforms with the approved plans and specifications."

Onsite inspections are conducted by either the Army Corps of Engineers, state, and/or EPA personnel. These inspections are conducted during (interim) and following completion (final) of construction. They are held to ensure that the facility is being managed properly, is on schedule, and is being constructed in accordance with approved plans, specifications, and change orders. These inspections are done to protect the interest of the state and federal government as well as the grantee.

Other inspections are carried out by the resident engineer. The resident engineer is the onsite representative of the consultant. The resident engineer ensures that sound engineering and construction practices are used. In general the resident engineer's responsibilities and duties are the same as the Corps', state's, and/or EPA inspector's. In addition the resident engineer is responsible for as-built drawings. As a representative of the consulting engineer, the resident engineer is mainly responsible for protecting the consultant engineering interests as well as those of the grantee and government.

40 CFR 35.935-8 requires competent and adequate engineering supervision and inspection by the grantee. It is important that the grantee (for its own self interest) has its own independent inspector. This inspector should be independent of the government and consulting inspectors. He/she should have the authority to act for the grantee to ensure that the facility is constructed properly. The grantee will have to live with the facility long after the engineer and government have left the site.

It is very important that the grantee has the capability of conducting its own inspections. The grantee cannot always depend upon the EPA/state/ Corps inspectors or the resident engineer to conduct inspections. The government inspectors and the resident engineer may not always be available to conduct inspections. Therefore, if the grantee wants to ensure that the wastewater treatment facility is constructed properly it should conduct its own independent inspections

The need for onsite locally controlled inspections by the grantee is exhibited in the following case histories.

Case History 1

A sewerline was being constructed for a town in West Texas. This area of Texas consists primarily of limestone covered with a shallow layer of soil. Trenches were dug haphazardly and contained numerous curves. The resident engineer and EPA inspector approved the trenches. Pipe was laid, but no provision was made for bedding. A pile of rocks supported the pipe at various intervals. This construction practice was approved by the resident engineer and the EPA inspector. The trenches were then backfilled with the original material which contained a large amount of rock with little soil. This backfilling work was also approved.

This town has experienced numerous problems with line stoppage, line breakage, and septic sewage. Had the inspection been controlled by the grantee, many improper construction methods could have been prevented.

Case History 2

An oxidation ditch (race track) was being constructed for a city of 30,000. This city had several inspectors in its building inspection department. These inspectors conducted onsite inspections of the oxidation ditch even though EPA and the resident engineer had conducted these inspections. The city inspector discovered that the inside wall for one of the turns was not constructed properly. The contractor was informed. The contractor stated that the wall had been approved by the resident engineer and EPA inspector. The city's inspector made the contractor rebuild the wall to conform with approved plans and specifications and sound construction practices.

These two case histories illustrate the importance of onsite locally controlled inspection capability.

DECISIONMAKERS: THEIR RESPONSIBILITIES

There are many decisionmakers involved in the construction grants process. These include the following:

1. Grantee
2. Consultant
3. Contractor
4. EPA
5. State

DECISION MAKERS

Each of these decisionmakers has specific responsibilities and liabilities. Some of these may be found in the Federal Register (Wednesday, September 27, 1978) Part III Environmental Protection Agency, Municipal Wastewater Works Construction Grants Program Title 40, Part 35, Subpart E sections:

35.936-5 Grantee Responsibilities
35.937 Subagreements for Architectural or Engineering Services
35.938 Construction Contracts
Appendix C-1 Required Provisions--Consulting Engineering Agreements
Appendix C-2 Required Provisions--Construction Contracts

40 CFR 35.936-5 outlines the grantee's responsibilities for administration and successful accomplishment of the project. This includes accomplishing all tasks required to plan, design, and construct a wastewater treatment facility that is flexible, operable, maintainable, reliable, durable, cost-effective, and in compliance with all local, state, and federal regulations.

Sections 40 CFR 35.937 through 35.937-12 outline the types of subagreements for architectural and/or engineering services. The grantee should become familiar with the contents of these sections. This will enable the grantee to enter into a subagreement that will lead to an operable wastewater treatment facility.

40 CFR 35.938 through 35.938-7 include the requirements, responsibilities, and liabilities that should be incorporated into contracts and subagreements for construction of the wastewater facility. These sections detail the

type of contract, advertising, change orders, payments, and what must be done by all parties involved in the construction of the facility.

40 CFR Appendix C-1 Required Provisions--Consulting Engineering Agreements and Appendix C-2 Required Provisions--Construction Contracts are very important to the grantee and the consulting engineer.

Appendix C-1--Required Provisions--Consulting Engineering Agreements details the requirements for the following:

1. General
2. Responsibility of the Engineer
3. Scope of Work
4. Changes
5. Termination
6. Remedies
7. Payment
8. Project Design
9. Audit; Access to Records
10. Price Reduction for Defective Cost or Pricing Data
11. Subcontracts
12. Labor Standards
13. Equal Employment Opportunity
14. Utilization of Small or Minority Business
15. Covenant Against Contingent Fees
16. Gratuities
17. Patents
18. Copyrights and Rights in Data

Appendix C-2--Required Provisions--Construction Contracts details the supplemental general conditions for the following:

1. General
2. Changes
3. Differing Site Conditions
4. Suspension of Work
5. Termination for Default; Damages for Delay; Time Extensions
6. Termination for Convenience

7. Remedies
8. Labor Standards
9. Utilization of Small or Minority Business
10. Audit; Access to Records
11. Price Reduction for Defective Cost or Pricing Data
12. Covenant Against Contingent Fees
13. Gratuities
14. Patents
15. Copyrights and Rights in Data
16. Prohibition Against Listed Violating Facilities
17. Buy American

The grantee must become familiar with these CFR's and appendices mentioned in the preceeding paragraphs. The grantee must ensure that the consultant follows the requirements of the CFR's and appendices and that an operable facility is constructed.

Although the main focus of the CFR's is on the grantee's responsibilities, it also outlines state and/or EPA responsiblities. Generally, the EPA will review grantee compliance with federal requirements applicable to the grantee's procurement. The state's responsibilities are similar to those of EPA, especially in those states which have been delegated authority for construction grants review and approval. Also, the states are responsible for periodically inspecting the treatment facility (after it is on line) for compliance with NPDES requirements and for proper and effective O&M.

If all decisionmakers implement their responsibilities as outlined in the CFR's and the appendices, then the operational considerations (flexibility, operability, maintainability, durability, cost-effectiveness) will be included in the planning, design, construction, and operation of the facility.

UNIT THREE
OPERATIONAL CONSIDERATIONS

OUTLINE

I. OPERATIONAL CONSIDERATIONS IN THE CONSTRUCTION GRANTS PROCESS 3- 2
II. PROBLEMS THAT MAY DEVELOP IF O&M IS NOT CONSIDERED IN STEP 1 3-12
III. PROBLEMS THAT MAY DEVELOP IF O&M IS NOT CONSIDERED IN STEP 2 3-16
IV. PROBLEMS THAT MAY DEVELOP IF O&M IS NOT CONSIDERED IN STEP 3 3-18
V. PROGRAM DOCUMENTS 3-20
VI. CASE STUDIES OF SUCCESSFUL AND UNSUCCESSFUL PROJECTS 3-23
VII. OPERATIONAL CONSIDERATIONS IN DESIGN 3-25

OBJECTIVES

Following the completion of Unit Three, the participant will be able to:

1. Identify and discuss O&M requirements in the Step 1 and Step 2 grant process
2. Describe at least three operational problems that can develop if O&M is not considered in Step 1, Step 2, and Step 3
3. Discuss the importance of O&M as outlined in the program documents concerning O&M
4. Use various O&M checklists
5. Obtain copies of the program documents
6. Discuss case histories of successful and unsuccessful projects and state at least two specific reasons for the success or failure of each

OPERATIONAL CONSIDERATIONS IN THE CONSTRUCTION GRANTS PROCESS

An applicant is usually unfamiliar with the requirements and/or limitations of the construction grants program. Federal regulations encourage preapplication conferences with the applicants who are on the state priority list and with state and regional EPA representatives. These conferences set the stage for a good working relationship. While the preapplication conference is optional, its importance cannot be overemphasized.

Topics to be discussed at the preapplication conference include:

1. All three steps in the grant process with special emphasis on Step 1
2. Contracts for personal and professional services
3. Administrative requirements
4. Technical requirements
5. O&M considerations

The following checklist contains the O&M considerations that should be discussed at a preapplication conference.

PREAPPLICATION CONFERENCE

O&M CONSIDERATIONS FOR DISCUSSION

1. O&M requirements are described in 40 CFR 35.925-10 (Operation and Maintenance Program), 40 CFR 35.935-1 (Grantee Responsibilities), and 40 CFR 35.935-12 (Operation and Maintenance).
2. Facility plans must include cost-effectiveness analyses that contain evaluations of improved effluent quality attainable through optimum operation and maintenance of existing facilities as an alternative or supplement to construction of new facilities [40 CFR 35.917-1(b)].
3. Proper operation and maintenance of federally funded facilities is a long-standing requirement [PL 84-660, Section 8(b); PL 92-500, Section 204(a)(4); 40 CFR 35.935-12]. Inadequate operation and maintenance can cancel federal expenditures on facilities designed to abate municipal

pollution. Grantee may be ruled nonresponsible with respect to applications of grants unless existing federally funded facilities are adequately operated and maintained [40 CFR 35.935-1]. (Note: EPA/state personnel should review grantee files to verify adequacy of existing facility O&M.) Step 1 grants can be awarded conditionally based on improved O&M. The scope of work for plans of study could include early evaluation of existing facility O&M and recommendation of necessary improvements. Upon completion of these improvements, Step 1 grants could then be awarded.

4. The accountability of each party involved in the grant as outlined in 40 CFR 35.936-5, Grantee Responsiblities; 35.937, Subagreements for Architectural or Engineering Services; 35.938, Construction Contracts (Subagreements) of Grantee, and 40 CFR Appendix C-1, Required Provisions--Consulting Engineering Agreements and Appendix C-2, Required Provisions--Construction Contracts.
5. Grantee needs to document influent characteristics (flow and load) for planning and design purposes.
6. Describe the plan of operation and its purpose. 40 CFR 35.935-12 states that it must be prepared and that it is grant eligible (PRM 77-3).
    a. Preliminary plan must be submitted with plans and specifications [40 CFR 35.920-3(c)(3), Contents of Application].
    b. Final plan must be submitted and approved before 50 percent of the Step 3 grant payment is made (PRM 77-3).
7. O&M manual must be prepared (40 CFR 35.935-12).

   Note: Writing should start when the design engineer begins design.
    a. Draft manual must be submitted by the time 50 percent of the Step 3 grant payment is made.
    b. Final manual must be submitted by the time 90 percent of the Step 3 grant payment is made.
    c. Early preparation of the O&M manual will help to assure that necessary controls are included in the design, because the design engineer is aware of O&M and will design accordingly.
8. Planning for start-up services should begin early. Start-up services help to assure that plant is placed in efficient and effective operation. Start-up services are grant eligible (PRM 77-2).

9. User charge system must be developed.
10. Funding of O&M budget must be considered.
11. Pretreatment of industrial waste is required.
12 Explain the operability review process that is used by the state (i.e., at what percentage points of completion of the plans and specifications will the reviewer conduct the operability review).
13. Discuss the importance of in-house operability reviews by the consultant. This review will aid in reducing possible revisions later. The in-house operability review by consultant is a quality control procedure that should be used in developing a facility plan, construction plans, and specifications.

Plan of Study

Prior to the development of a facility plan the applicant must prepare a plan of study. The cost of preparing the plan of study is not grant fundable and must be paid for by the applicant.

The plan of study outlines the work involved in the preparation of a facility plan. This is the first element of the grant request that must be submitted by the applicant. The plan of study should provide a brief description of the following:

1. Facility planning area
2. Entity or entities doing the planning and legal description of their ambient of power
3. Nature and scope of the problem
4. Tasks, schedule, and costs of the facility plan preparation
5. Any significant public comments

PLAN
OF
STUDY

Facility Plan

The degree of treatment which must be provided by a particular treatment plant is dictated by the effluent limitations. Public Law 92-500 established the National Pollution Discharge Elimination System (NPDES) which sets effluent limitations. These effluent limitations include biochemical oxygen demand (BOD_5), suspended solids, and other parameters establishing the

An infiltration/inflow (I/I) analysis should indicate the:

1. Cost of transporting I/I
2. Cost of treating I/I
3. Cost of removing all or part of I/I
4. Amount of I/I to be removed and amount to be left
5. Need for a sewer system evaluation survey
6. Results of correcting I/I on public versus private property

The facility plan may contain a sewer system evaluation survey. This survey is conducted only if the I/I analysis indicates that excess I/I exists. The evaluation survey consists of some or all of the following:

1. A physical survey of the system
2. Smoke bomb or air pressure testing
3. Selected sewer system cleaning
4. Visual (TV or photographic) inspection of selected sewer sections
5. Preparation of a report

The evaluation survey will identify specific sections of the sewer system which must be repaired by:

1. Grouting
2. Sealing
3. Lining
4. Replacing

The public should participate from the beginning in facility planning. This allows interests and potential conflicts to be identified early and considered as the planning proceeds. The construction grant program requires a public participation program. Consistent with Section 101(e) of the Clean Water Act and 40 CFR Part 25, EPA, the state and grantee shall provide for, encourage, and assist public participation in the facilities planning process. They shall provide the citizens with information about and opportunities to become involved in the planning process. Public hearings should:

1. Define issues
2. Analyze information
3. Explain all costs with estimated infiltration factors

4. Discuss alternatives
5. Allow all interests to be heard
6. Emphasize O&M cost, including how they are to be provided for in order to ensure proper O&M
7. Management responsibility

Public involvement can be achieved through the use of:

1. Advisory groups
2. Public meetings and hearings
3. Workshops
4. Mailings
5. Seminars
6. News media
7. Surveys

PUBLIC
HEARING

After all investigations and alternatives are evaluated as part of a facility plan, one alternative is selected and described in greater detail. The selected plan describes the project for which Step 2 and Step 3 construction grants may be requested by the applicant.

The three levels of a facility plan are:

1. Review by clearinghouse
2. Review by state
3. Review by EPA

EPA will review for approval only those facility plans which have received clearinghouse and state approval. The EPA Regional Administrator has the authority to approve any facility plans submitted by a state within his/ her region. The applicant is then ready to complete the application for a Step 2 grant.

Upon successful completion of a Step 1 grant, the applicant may apply for a Step 2 grant. At this point, a predesign conference is desirable.

The applicant, engineer, state, and/or EPA personnel, the O&M person, and chief operator should meet in a predesign conference.

All parties at the predesign conference should be keenly aware of the necessity of considering O&M in the design of the plant. Using a predesign conference checklist is desirable. From the information on this checklist the applicant will become familiar with the O&M requirements of Step 1. The participants in a predesign conference should cover the following O&M considerations:

PREDESIGN CONFERENCE
O&M CONSIDERATIONS FOR DISCUSSION

PRM
77-3
40
CFR
35.920-3

1. Plans and specifications must emphasize operability, flexibility, and maintainability of each unit process and of the overall facility. A matrix on major design errors is being developed by the Municipal Environmental Research Laboratory, USEPA, Cincinnati, Ohio, and should be used when it becomes available.
2. A Preliminary Plan of Operation must be submitted with plans and specifications; 40 CFR 35.920-3(c)(3); 40 CFR 35.925-10; 35.935-12; (PRM 77-3).
3. Staffing and training analysis:
   The facility must be designed to operate effectively with the minimum number of O&M staff. Considerations include:
   a. Availability and skills of existing facility personnel
   b. Salary ranges for plant personnel, if local salary scales will not attract skilled personnel
   c. Additional personnel and skills needed
   d. Personnel training needs prior to plant start-up
   e. Personnel training needs after start-up (ongoing training)
4. Emergency operating plan should cover the following as a minimum:
   a. Effects of emergencies
   b. Vulnerability analysis of the system
   c. Protection measures
   d. Emergency response program
5. Operability reviews of the plans and specifications will be conducted by the state, and the review process should be explained.

6. Operability reviews should also be conducted by the consultant. This would be an in-house quality control procedure that should be used when developing plans and specifications. This type of review will aid in minimizing possible revisions later.
7. Flexibility of plant operation is necessary to permit:
    a. Optimization of process control
    b. Maintenance of process units
    c. Emergency operation
    d. Process control procedures
    e. Sludge disposal
    f. Proper sampling procedures
    g. The achievement of effluent standards
    h. Varying hydraulic and organic loading in industrial waste
8. A preventive maintenance program, including a records system, is to be designed and initiated prior to facility start-up.
9. Influent, effluent, and process control laboratory testing, including sampling locations, is to be established.
10. Operating budget, user charge, and industrial recovery system are required and must be available.
11. Start-up service requirements include a subagreement proposal (i.e., for consultant services) which is drafted for submission with the Step 3 grant application (PRM 77-2).
12. Sewer use ordinance requirements should be discussed.
13. Pretreatment ordinance requirements should be discussed.
14. Line item costs must be determined for:
    a. Plan of operation preparation
    b. Start-up service subagreement
    c. O&M manual preparation
15. Periods of raw sewage bypassing and other facility treatment disruptions which violate discharge permit conditions must be avoided during new facility construction.
16. Influent characteristics must be documented for design purposes.
17. The responsibilities and liabilities of the grantee, consultant, contractor, EPA, and state as outlined under the following statutes:
    a. 40 CFR 35.935-5 Grantee's Responsibilities
    b. 40 CFR 35.937 Subagreements for Architectural or Engineering Services

c. 40 CFR 35.938 Construction Contracts (Subagreements) of Grantees

d. Appendix C-1 of 40 CFR Required Provisions Consulting Engineering Agreements

e. Appendix C-2 of 40 CFR Required Provisions Construction Contracts

The end product of the Step 2 detailed design is a set of plans, specifications, and detailed construction cost estimates which are suitable for bidding and construction purposes and for designing the preliminary plan of operation.

A plan of operation is required for all wastewater treatment plants. The plan should include a list of actions needed to ready the plant and its personnel for operation when construction is completed. A plan of operation should consider:

1. Staffing requirements
2. Training requirements
3. O&M procedures
4. Records and reports
5. Laboratory testing
6. Maintenance management
7. O&M manual
8. Operation budget
9. Other elements necessary to assure timely implementation of all actions related to continued, efficient, and reliable operation of the facility such as:
   - a. Laboratory quality control
   - b. Process control
   - c. Start-up procedures
   - d. Safety
   - e. Emergency operating plan
   - f. Sewer use ordinance
   - g. Pretreatment ordinance
   - h. Annual O&M report

Prior to construction, it is desirable for a preconstruction conference to be conducted. At this conference, the grantee will be informed of O&M requirements that must be complied with during Step 3. The following items should be discussed at the preconstruction conference:

PRECONSTRUCTION CONFERENCE
OPERATION CONSIDERATIONS FOR DISCUSSION

1. Was compliance with state and local law and ordinances discussed?
2. Has a preliminary plan of operation been approved?
3. Have start-up service provisions been approved?
4. Has a completion schedule for the following been submitted:
    a. Final plan of operation
    b. Draft of O&M manual by 50 percent payment
    c. Final O&M manual by 90 percent payment
    d. Staffing and training
        1. Hiring of chief operator by 50 percent
        2. Training program developed and implemented prior to start-up
        3. Chief of maintenance and instrumentation should be hired by 50 percent where applicable
        4. Construction manager designated and his/her responsibilities explained
        5. Adequate legal advice obtained by grantee
5. Have requirements for the submission of the following been discussed:
    a. A user charge system
    b. Industrial cost recovery system
    c. Sewer use ordinance
6. Were the requirements for adequate engineering supervision and inspection during construction discussed? (40 CFR 35.935-8)
7. Have construction schedules/procedures been established to avoid raw sewage bypassing and other existing facility treatment disruptions?
8. Have procedures been provided to protect and maintain equipment in storage and in place during construction prior to plant start-up?
9. Have the influent characteristics upon which plans and specifications were based been confirmed through sampling and analysis by 50 percent completion of construction?

10. Was applicant informed that O&M inspections and onsite construction inspections will be held?
    a. Will an interim inspection be held?
    b. Was applicant informed that a final inspection will be held?
    c. Other inspections that inspectors deem necessary may be held
11. Were changes in plans and specifications during construction approved by state and EPA prior to execution discussed?

PROBLEMS THAT MAY DEVELOP IF O&M IS NOT CONSIDERED IN STEP 1

Operation and maintenance considerations may be overlooked when planning a wastewater treatment facility. This oversight has created many operation and maintenance problems for the operator. Major problems that have developed are:

1. Inadequate funding for O&M
2. Inadequate training for operators
3. Inadequate laboratory facilities
4. Nonexistent maintenance management programs
5. Useless O&M manuals
6. Inflexibility in the systems
7. Staffing difficulties
8. Lack of understanding on part of governing body

The lack of adequate funding for O&M is a major problem. Utility owners (city officials and the public) must provide the money needed to get the job done. The applicant must be aware of the program requirements for O&M funding (40 CFR 35.935-1, Grantee Responsibilities). To meet these requirements the applicant must make provisions for sufficient O&M funding. A user charge system must be developed. The wastewater treatment facility is a separate utility and must be a self-supporting budgeted utility. If these O&M requirements are ignored, then adequate funding of O&M is jeopardized.

Along with O&M funding, operator training is a major problem. The grantee should provide qualified trained personnel and pay adequate salaries. This is impossible without knowledge of O&M requirements such as funding for pre- and poststart-up training as defined in PRM 77-2 and training as part of the plan of operation (PRM 77-3). Additional training should be required to strengthen the operator's skills. Without training, or with insufficient training, there is little chance for proper and efficient O&M to be achieved. The grantee must provide for ongoing training after completion of the project.

Another problem is the lack of laboratory facilities. Laboratory testing procedures are necessary to determine the efficiency of plant operation, to provide for process control, and to ensure compliance with the NPDES permit. Without these procedures, poor operation practices may result. In addition, there is no way to monitor NPDES permit compliance.

Operation and maintenance also suffers when an effective maintenance management program is not developed. If the operator does not know what preventive maintenance is needed, or when it is needed, it cannot be performed properly. Many undesirable consequences result from a lack of proper maintenance. The grantee may face:

1. High repair and replacement cost
2. Plant shut-downs
3. Improperly operated plant
4. NPDES permit violations
5. Lawsuits

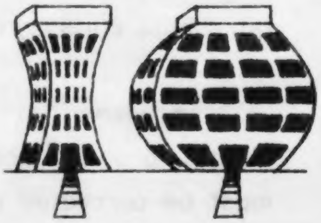
This maintenance program is part of the O&M manual requirements. Early knowledge (prior to Step 1 application) of the need for an O&M manual will provide an opportunity to establish an efficient maintenance management program.

A wastewater treatment system needs to be flexible. The operator must be able to make changes in the operation of the treatment plant. If these changes cannot be made, then O&M of the plant is impaired. Flexibility is an O&M necessity that must not be omitted.

Staffing is another problem the applicant will face. For example, the Imhoff tank with an oxidation pond may require a minimally skilled, part-time operator, while the new wastewater treatment facility (an extended aeration plant) would require several full-time, highly skilled operators. The applicant must be able to attract these operators in order to staff the treatment works properly. This is not always an easy task and often means higher salaries for more people.

The grantee faces problems, not only after the system is on line, but throughout the entire grant process. From the beginning of the grant process, O&M concerns must be emphasized. If the applicant develops a plan of study deficient in O&M concerns, the result will be delays in approval and increased costs which the applicant has to fund. Not only would the plan of study be faulty, but the applicant would not be aware of its responsibility for O&M. Without knowledge of O&M requirements (user charges, funding of O&M, etc.) the applicant may develop an erroneous cost/benefit analysis which will result in improper plan selection. The applicant may select a plan that will cause bankruptcy if the treatment plant is operated properly. The plan selected may also call for trained operators that are not available to the applicant. The problems alone would prevent the applicant from operating and maintaining the treatment plant properly.

Plant size is often another problem. Influent characteristics (flows and loads) used for planning and design must be documented. Undocumented characteristics will result in a plant that is either oversized or undersized. An undersized plant (hydraulically and/or organically) may be difficult to operate to obtain the desired effluent. It will have to be modified to handle the influent characteristics. Until these expensive modifications are made, the plant will continue to produce a poor quality effluent.



An oversized plant will also create O&M problems. The user charge to fund O&M may be unrealistic. If everything at the plant is oversized (labs, pumps, etc.) O&M costs will be excessive and the plant may not be able to produce the desired effluent due to underloading. Plans that have not given proper consideration to flexibility may produce a poor quality effluent.

Another important O&M requirement is the plan of operation. The applicant must be able to develop a reliable plan of operation which includes a statement of what must be done and when it must be done. This assures proper and efficient start-up and continued operation. Early knowledge of PRM 77-3 (Plan of Operation For Municipal Wastewater Treatment Facilities) will enable the applicant to develop a usable plan of operation at the beginning of the grant process.

Early knowledge of the O&M manual requirement is a must. The applicant's design engineer should begin the project with the O&M manual in mind. As the project progresses, a better design may be the result. A better designed plant may eliminate many O&M problems. If the O&M manual requirement is not discussed early, a poorly designed plant with an unusable manual could be the result.

Improper start-up of the treatment works presents another potential problem. This causes delays and problems in achieving operational objectives which may take weeks, months, or years to correct. Some problems associated with start-up are lack of trained personnel, development of unsafe O&M procedures, inferior operation procedures, and improper operation of equipment. The applicant must be informed early of PRM 77-2 and encouraged to use it so start-up services can be planned from the beginning of the construction grants process. From the facility plan comes the design phase and its plans and specifications. Without O&M concerns, the design phase may result in a process and control system that cannot be used to operate the plant efficiently. The lack of O&M concerns will also result in the use of unreliable equipment.

In many instances the grantee understands neither the construction grants process nor wastewater treatment practices. This misunderstanding must be corrected if O&M problems are to be reduced.

PROBLEMS THAT MAY DEVELOP IF O&M IS NOT CONSIDERED IN STEP 2

O&M considerations may be overlooked when designing a wastewater treatment facility. Many O&M problems have been created by design errors. Some of these problems are:

1. Lack of grit removal
2. Inadequate consideration of flow and load variations
3. Effects of climate
4. Poor hydraulic arrangement (lack of flow splitting)
5. Lack of hoists to remove pumps, large objects, etc.
6. Inefficient equipment placement
7. Lack of building hatches for openings for removal of large equipment
8. Inadequate consideration of industrial waste
9. Lack of consideration of treatability of combined waste (industrial and domestic)

The absence of grit removal has become a problem in many small treatment plants. In an effort to economize and reduce plant units, the process of grit removal is often eliminated. This omission should cease. Grit will cause excessive wear on pumps. It takes up space in aeration chambers and digestors and will have to be removed. This causes plant shutdown and unnecessary expense.

The variation of influent flow and load must be considered. Many designs do not consider flow and load at plant start-up. If the low flow at start-up is not considered, many operating problems will develop. For example, meters may not register the low flow and pumps, blowers, chlorinators, and other units may be oversized. Therefore, the designer must consider all types of flows and loads when designing a wastewater treatment facility.

The effect of climate on the treatment process is often overlooked. There are substantial differences in design approaches that result from various climatic conditions. The designer must consider local climatic conditions, such as adverse weather, when designing the wastewater treatment facility.

Hydraulic arrangement resulting in different modes of operation must be considered. Many designers have overlooked the importance of this. Design flexibility will greatly improve plant O&M.

The operator and maintenance personnel face many problems if hoisting equipment is not available. The ability to lift and remove pumps, motors, etc., is a must. It is difficult and time-consuming to have to dismantle a motor in order to get to a pump because there is no other means of removal. The design must provide for some means of using hoists, etc., in the removal of large, heavy pieces of equipment.

In equipment placement, the designer must consider:

1. The primary and secondary function of the equipment
2. Future plant expansion
3. Equipment controls location
4. The provision of working space for plant personnel
5. Maintenance requirements

If the designer does not consider the above factors, then plant O&M may be impaired. Some problems that may occur are Venturi meters that become clogged, pumps in deep pits which do not allow for maintenance or which do not have hoists for removal, and control panel access doors which may be located near the wall, making access impossible.

During the design phase of the project, the types and treatability of industrial waste must be considered. Provisions must be made for industrial waste that cannot be treated in a conventional wastewater treatment plant. If this is not done then the facility cannot be operated properly.

Obviously, these are not all of the problems that can develop if O&M is not considered in the design. However, these problems and others can be prevented if O&M is considered.

PROBLEMS THAT MAY DEVELOP IF O&M IS NOT CONSIDERED IN STEP 3

O&M consideration may be overlooked during the construction of a wastewater plant. Many problems that result from a lack of consideration for O&M in Steps 1 and 2 may extend into the construction phase. Some of the problems have already been discussed previously and will not be covered. However, some O&M problems that may develop are:

1. Lack of accessibility of underground piping
2. Blockage of hoist runways
3. Floors sloping away from drainpipe
4. Lack of or inaccessibility of meters and valves
5. Change orders
6. Cost overruns
7. Delay in meeting deadlines

During construction all underground piping should be clearly located. Care must be taken to avoid the placement of parking lots, buildings, tanks, etc., over the laid pipes. Under the guidance of the inspector the contractors must take steps to ensure that all piping is accessible.

Many traveling hoists have become useless because the I-beam has been blocked. The various contractors should coordinate their activities to prevent this problem from developing.

Standing water in many wastewater treatment facilities is a common problem to the operator. It is also a safety and health problem. Equipment is subject to flooding, causing operating problems. The contractor must ensure that all floors drain properly.

In many treatment facilities meters and valves are missing or are not accessible. This presents a real operating problem. Without any means to regulate them (or if it is next to impossible to reach meters and valves) flow process control is impossible. Without process control plant operation is impossible.

Change orders may result if O&M is overlooked in step 1 and 2. This process can be time-consuming and costly. This problem developed on a project in one of the New England states. The result was several month delay and changes that cost in excess of $ 750,000.

Sometimes O&M oversights will result in cost overruns. In most instances these additional costs will be borne by the grantee. This usually causes additional monetary burdens for the grantee.

Most contracts have deadlines for completion. If change orders are needed, then these deadlines may not be met. This usually throws the entire project off schedule resulting in:

1. Additional cost.
2. Equipment being exposed to elements.
3. Additional pollution to the environment.

It must be remembered that even if O&M is considered during Step 1, Step 2, and Step 3, many problems may develop, although at a significantly lower frequency.

PROGRAM DOCUMENTS

Many construction grants program documents have been developed. The documents come in many forms. They may be:

1. Laws
2. Regulations
3. Guidelines
4. Technical publications
5. Program Requirements Memoranda

These documents are designed to help the applicant/consultant in meeting all construction program requirements. All of these documents are important to the construction grants process.

Many of these documents (or parts of them) are directed specifically toward operation and maintenance of a wastewater treatment facility. These documents can be used by the applicants/consultants as an aid in designing and constructing an operable treatment facility. Some of the more important O&M documents will be covered briefly.

First, PL 92-500, section 204a, requires that all federally funded wastewater treatment plants be operated and maintained properly. If the grantee fails to do so, it may be subject to repayment of federal monies.

The regulation Title 40, Chapter 1, Subpart B, Part 35, Subpart E, details the grantee's responsibilities for the operation and maintenance of federally funded wastewater treatment facilities. This requirement can be found in several sections of Part 35.

40 CFR 35.935-1, Grantee Responsibilities, and 40 CFR 35.935-12, Operation and Maintenance, are two very important sections of 40 CFR Part 35. (These two sections will be found in the appendix of this handbook.) The grantee/consultant should review these sections. The grantee must understand the need to fulfill the requirements in 40 CFR 35.935-1 and 40 CFR 35.935-12 if it is to design and construct an operable treatment works.

Two important guidelines that address O&M are:

1. Federal Guidelines for Design of Wastewater Treatment Facilities, February 1976 (Reference Item #9, page R-2)
2. Federal Guidelines for Operation and Maintenance of Wastewater Treatment Facilities, EPA, August 1974 (Reference Item #8, page R-2)

These two guidelines were developed to emphasize a comprehensive strategy to obtain the highest levels of operational efficiency necessary to achieve water quality objectives throughout the nation. The grantee should obtain these guidelines and become thoroughly familiar with them.

There are numerous technical publications that directly or indirectly influence O&M. The grantee should obtain the following publications:

1. Handbook of Procedures, Construction Grants Program for Municipal Wastewater Treatment Works, MCD-03
2. Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, MCD-05
3. Model Plan of Study, Supplement to Guidance for Preparing a Facility Plan, MCD-24 (Reference Item #6, page R-2)
4. Guidance for Preparing a Facility Plan, MCD-46 (Reference Item #4, page R-2)
5. How to Obtain Federal Grants to Build Municipal Wastewater Treatment Works, MDC-04

These technical publications emphasize the importance of O&M of wastewater treatment facilities. They also explain the grantee's responsibility for meeting certain O&M requirements throughout the construction grants process. Utilization of the information found in these technical journals will assist in the formation of an operable facility.

The publications may be obtained from:

United States Environmental Protection Agency
c/o GSA-Centralized Mailing Lists Service
Bldg. 41, Denver Federal Center
Denver, Colorado 80225

It must be noted that there are other technical publications concerning O&M which are useful to the grantee in designing and constructing a wastewater treatment facility. A list of these and their sources can be obtained by ordering EPA form 7500-21 (Rev. 9-79) from the following address:

General Services Administration (8FSS)
Centralized Mailing Lists Services
Building 41, Denver Federal Center
Denver, Colorado 80225

In addition to these, EPA has issued Program Requirement Memoranda (PRM's). The PRM's are designed to assure uniformity in the construction grants program. There have been many PRM's issued; however, the two most important (relative to O&M) are:

1. PRM 77-3, Plan of Operation for Municipal Wastewater Treatment Facilities
2. PRM 77-2, Grant Eligibility of Start-up Services

These PRM's are available from regional USEPA offices.

In summary, the grantee should become familiar with construction grants program documents. This familiarity will enable the grantee to understand the need for O&M requirements throughout the construction grants process.

CASE STUDIES OF SUCCESSFUL AND UNSUCCESSFUL PROJECTS

Example of an Unsuccessful Project

A small west Texas town needed to either upgrade its present wastewater treatment facility or construct a new one. The town was not meeting its effluent criteria. The present system consisted of an anaerobic digester and trickling filters. There was only one full-time and two part-time employees. Most of the maintenance work was done by other city employees (water and street department). The present facility had no laboratory or equipment to monitor the treatment process; therefore, the plant was operated by guesswork.

The city council decided to apply for a construction grant. The city was on the state priority list and qualified to apply. An engineering firm was retained to develop the necessary documents for Step 1. No preapplication conference was held.

A plan of study (based on model plan of study) was prepared and submitted. It was approved.

After evaluating the alternatives (optimum O&M at existing facility was not considered), a plan was selected. The engineer's choice was an extended aeration treatment plant. Little attention was paid to the financial capabilities of the town or its citizens. The engineer underestimated the O&M cost of the plant. This went unnoticed by the reviewer either through neglect or lack of training in operational program requirements review.

This oversight in the Step 1 process resulted in a treatment facility that the town cannot afford to operate. The operator has been turning the blowers off at night. This poor operating procedure has resulted in numerous permit violations.

This O&M problem could have been prevented if future operation and maintenance costs were investigated and thoroughly considered in the plant selection process.

Example of a Successful Project

A treatment plant in east Texas consisted of an Imhoff tank. Sewage treatment was nonexistent. The Imhoff tank had been neglected for years. A new water and wastewater superintendent was hired to correct the problem. It became apparent that a new facility to meet secondary treatment standards was needed. The city was on the state priority list, and an engineering firm was retained to assist in the grant process and plant design.

A preapplication conference was held. At the conference the applicant and the engineer were informed of the construction grants requirements. O&M was stressed. The applicant was told that it would have to fund O&M of the plant after start-up. Other operational requirements were emphasized, such as the need for an O&M manual, training, and staffing. The applicant was also informed that if the plant was not properly operated and maintained, it could be required to refund all federal funds expended.

The applicant and engineer prepared a plan of study. Public input was encouraged by a series of town meetings. The costs to the citizens were explained at these meetings and in the local newspaper.

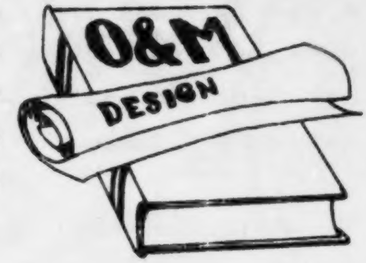
After collecting all data and evaluations, a plan was selected. The city and the engineer decided that an oxidation ditch was the best alternative.

This O&M consideration process resulted in a plant that meets or exceeds its permit. The plant design and layout lends itself to effective and efficient O&M. This plant received a BOD of 200 mg/l and 300 mg/l suspended solids. The plant achieved a 98 percent removal of BOD and TSS.

The city can afford to properly and efficiently operate and maintain this plant. The plant performance has been outstanding.

As a result of considering operation and maintenance and its cost, an operable wastewater treatment facility was selected, designed, and constructed.

OPERATIONAL CONSIDERATIONS IN DESIGN



The design of a wastewater treatment facility can influence facility operation and maintenance more than any other function. The design will set the stage for operation and maintenance needs and attitudes. The designer must always be aware of the relationship between O&M and plant design.

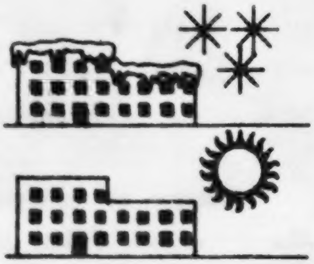
There are many design considerations that will affect the operability of the treatment facility. The grantee should become familiar with these considerations. The grantee will then know what to look for to ensure effective and efficient plant O&M.

One of the first design considerations is the plant site. The site can place many restrictions on the design. The availability or shortage of land will affect the size, layout, and shape of the proposed facility. Future expansion may be limited or impossible. Environmental restrictions may make it impossible to operate or maintain the facility. For example, a plant in a swamp or flood plain will have severe O&M problems. Natural limitations of the site may create operational problems that cannot be overcome. Problems in political jurisdiction of sites may arise. These also will have to be considered and resolved. In addition, the use of existing facilities may create O&M problems and must be considered. Operational problems created by their design may be carried over into the new plant. Site constraints that may adversely affect operation and maintenance of the new facility must be considered and compensated for in the design.

The influent characteristics must be considered in the design of the treatment facility. This is why documentation of flow and load was required in Step 1. The objective of a wastewater treatment facility is to produce an effluent of a certain quality. To accomplish this, the design must allow for variation of influent flow and load. Of equal importance when considering flow and load is the effect of "recycled loads." Allowance for supernatant liquor, sludge thickener overload, and other sludge liquor returns must be considered. These returns will cause variations in flows and loads. The design must be flexible enough to allow for efficient plant operation under all load conditions.

Plant size and its relation to simplicity and flexibility is an important operational consideration in design. During the plant design process, alternatives are compared and a selection is made. The selected design should minimize the number of unit operations required of the operator. This simplicity of design must not result in operating headaches in the future. For example, some designers have omitted grit chambers to reduce unit operations. This practice has led to many O&M problems after start-up. The reviewer should use caution when reviewing for simplicity and flexibility in design.

The layout of the plant must be done with O&M in mind. It is imperative that the layout provide visibility and accessibility from one structure to another. The placement of plant components on the site will affect the staff's attitude toward the wastewater treatment plant. Convenient and logical placement of plant components can reduce the amount of time and work required to operate and maintain the treatment plant. In small plants a centrally located operation building can simplify plant operation. This central location allows for ease of operation and maintenance for the operator. The operation can be controlled from one building. In large plants, satellite operation centers may be needed. The use of centrally located operation buildings or satellite buildings reduces the complexity of operation for the operator. The simpler the operation, the better the operator will perform his/her duties.



Climate needs to be considered in the design of a treatment plant. Substantial differences in design will result from an appraisal of local climatic conditions. The climate will affect drainage, component housing, protection from wind, drying bed design, materials used, and even the treatment process. Open drying beds may work in a west Texas town where evaporation is high, but it would not work in areas of high rainfall. The design should consider adverse weather and its effect on operation and maintenance. A design which is not based upon climatic conditions, including inclement weather, will result in operational problems at the proposed treatment plant. The reviewer should ensure that the designer has considered the effects of climate in the design.

Another important operational consideration in design is materials handling. The designer must recognize this, and consider what will be involved for the operator. The materials must be identified as to type, quantity, shipment sizes, frequency of delivery, and residues to be removed. Unnecessary handling of materials should be avoided.

Plant hydraulic arrangement has a dramatic effect on plant operations. The piping arrangement should be designed to allow unit removal without causing a downstream or upstream unit removal. For instance, removal of a settling tank should not cause the upstream aeration tank to be removed as well. Flow routing should be flexible to allow for various modes of operation. An example of this is to arrange piping to allow an activated sludge plant to be operated as an extended air or contact stabilization plant. Piping should allow for the equal distribution of solids and liquids. Pumping arrangements should allow one pump to pump from one unit or from several units. In general, the hydraulic arrangements should allow flexible operation.

Equipment selection has a major impact on plant operation and maintenance. The need to control the quality and special features of equipment is very important. Savings in capital outlay may be offset by increased operation and maintenance. The program requirement of "two brand names or equal" may be causing the use of inferior products or equipment in wastewater treatment plants. The plans and specifications and the consultant should ensure that the equipment used is equal to the brand name equipment in quality. This will reduce possible O&M problems.

Design of a treatment plant should embrace the concept of flexibility. Many factors which influence plant operation often change without warning. Changes such as flow and load, staff capabilities, maintenance requirements, and regulatory requirements create the need for plant flexibility. If the design allows for operational changes, then O&M of the plant should be easier.

Component reliability in design is a must. Duplicate or backup systems need to be included in the design.

Safety in design is a very important consideration. It is necessary to ensure that the operator has a safe environment in which to work. If operators feel that various operational duties are unsafe, they will not perform the necessary O&M tasks. The grantee must be aware of the importance of safety in the design process and in the review process.

Operational considerations in design are very important. In order to provide for O&M considerations, the design should exhibit:

1. Flexibility: The ability to change modes of operation easily without disrupting the process
2. Operability: The ability of the operation to produce the required effluent under various flows and loads without disrupting the process
3. Maintainability: The ability to perform maintenance tasks without disrupting the process
4. Reliability: The ability to perform the designated function consistently without disrupting the process
5. Durability: The ability to function satisfactorily for a specified time without disrupting the process
6. Economy: The ability to produce the required effluent at the lowest possible cost

The absence of any one of the above will reduce the operational performance of the wastewater treatment plant.

UNIT FOUR
PLAN OF OPERATION

OUTLINE

I. MONITORING CONSULTANT ACTIVITIES 4- 2
II. USE OF PRM 77-3 4- 3
III. USE OF REVIEW OPERATION CHECKLIST 4-16
IV. EXAMPLE OF AN ACCEPTABLE PLAN OF OPERATION 4-20

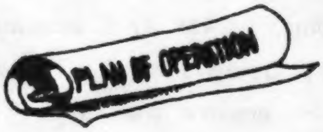
OBJECTIVES

Following the completion of Unit Four, the participant will be able to:

1. Utilize a plan of operation to ensure that specified tasks are completed at the proper times
2. Evaluate a plan of operation using PRM 77-3 and the Review Operation Checklist
3. Use examples of plans of operation as guides in evaluating his/her own plan of operation

MONITORING CONSULTANT ACTIVITIES

A plan of operation is required for all federally funded wastewater treatment facilities. This requirement is found in Section 204(a)(4) of the Federal Water Pollution Control Act Amendments (PL 92-500). Additional requirements are found in 40 CFR 35.935-12 of the Federal Register. Guidelines for the development of a plan of operation can be found in the Program Requirements Memorandum, 77-3, Plan of Operation for Municipal Wastewater Treatment Facilities and Federal Guidelines - Operation and Maintenance of Wastewater Treatment Facilities, EPA, August 1974 (Reference Item #8, page R-2). These guidelines detail the information that should be covered by the plan of operation.



The plan of operation identifies tasks that must be performed throughout Step 3, prior to start-up, during start-up, when preparing the O&M manual, and long after the grant is closed out. It provides an implementation schedule of the steps which must be followed to ensure cost-effective, efficient, and reliable start-up and continued operation and maintenance of the wastewater treatment facility. In addition, it outlines the purposes, locations, and timeframe of each task and designates specific staff responsibilities.

The plan of operation can be used by the grantee to monitor consultant activities. By comparing the consultant's actions to requirements outlined in the plan of operation (including implementation dates), the grantee will be able to evaluate the progress made toward fulfilling the requirements.

USE OF PRM 77-3

It is important that the grantee understand and use PRM 77-3. It was issued by EPA as a guide to assist in the developement of the plan of operation. PRM 77-3 contains the minimum requirements for a plan of operation. By using PRM 77-3 and the accompanying checklist on page 4-16, the grantee can ensure that a usable plan of operation is developed. A copy of PRM 77-3 follows:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CONSTRUCTION GRANTS PROGRAM REQUIREMENTS MEMORANDUM
PRM #77-3

DATE: November 29, 1976

SUBJECT: Plan of Operation for Municipal Wastewater Treatment Facilities

FROM: John T. Rhett, Deputy Assistant Administrator for Water Program Operations (WH-546)

TO: Regional Administrators I - X
ATTN: Water Division Directors

PURPOSE

This memorandum provides guidance on preparing a Plan of Operation for municipal wastewater treatment facilities being constructed, modified, or expanded under the Construction Grants program.

DISCUSSION

Section 204(a)(4) of the Federal Water Pollution Control Act Amendments (PL 92-500) requires all municipal wastewater treatment facilities constructed with Federal funds to have a Plan of Operation. This memorandum contains guidance for the development of such a Plan. Additional details on this requirement can be found in 40 CFR 35.935-12 of the Federal Register.

A Plan of Operation is intended to identify specific actions and related completion dates to assure that the facility and all associated personnel are properly prepared for start-up and continued operation. Actions identified will be responsive to all technical and administrative requirements for efficient and reliable performance, including all such elements outlined in the Operation and Maintenance (O&M) Manual. A Plan of Operation is not intended to supplant the O&M Manual, which provides long-term guidance for efficient facility operation and maintenance, but rather summarizes the actions necessary to assure that all steps required for start-up and operation are taken at the appropriate times. The Plan of Operation provides detail on such matters as who will perform the necessary tasks, when and how they will be undertaken, and, where necessary, the nature of each task. For example, the O&M Manual will indicate the staffing and personnel training needs for the facility; the Plan of Operation will contain the actual schedule to be followed for hiring and/or training those personnel.

POLICY

Plans of Operation must be submitted and approved to meet requirements of Section 204(a)(4) of PL 92-500 and 40 CFR 35.935-12. Content of the Plans of Operation and timing for completion and submittal should follow the guidance of the Memorandum and the attachments thereto. The Plan of Operation shall provide a concise, sequential description of, and implementation schedule for, those activities necessary to assure cost-effective, efficient and reliable start-up and continued operation of the facility. The cost of preparing a Plan of Operation is grant eligible and should be identified as a separate line item in the project costs.

IMPLEMENTATION

Municipal wastewater treatment facility construction projects vary considerably in size and complexity, and the degree of detail in a Plan of Operation should reflect this variation. The Plan of Operation must be tailored to the specific needs of each individual project. The basic guidance document for the development of a Plan of Operation is Federal Guidelines - Operation and Maintenance of Wastewater Treatment Facilities, published by EPA in August 1974. Application of this guidance to the development of a Plan of Operation is discussed in Attachment "A" to this PRM entitled "Basic Considerations in the Development of a Plan of Operation for Wastewater Treatment Plants."

A "sample" Plan of Operation is presented in Attachment "B." This sample illustrates one format for a Plan. The action items shown are not all inclusive, nor does each of these items necessarily apply to every project. An alternative format would be a time based chart that displays graphically the time span over which items would be completed. In this case appropriate narrative should be included to provide a full understanding of each area of activity. Reference to the O&M manual should be utilized whenever possible to avoid duplication.

Hereafter, grantees should submit a preliminary Plan of Operation along with the construction plans and specifications. This preliminary Plan of Operation should be reviewed by the State Water Pollution Control Agency concurrently with the review of project plans and specifications. If the plan is incomplete or in need of corrections, resolution should be accomplished in the same way that problems encountered in the processing of plans and specifications are now resolved. Certain information needed to complete a Plan of Operation, particularly the timing for implementing certain items, will not be known until the construction phase of the project is underway. In a preliminary Plan, therefore, it may be necessary to define implementation schedules either in terms of an estimated percent of completion of construction, or, in terms of a certain number of days before an operation start date. In fact, it may not be possible to identify all necessary actions related to operations in the preliminary Plan, although it should be as complete as possible.

It is not required to amend existing Step 2 and Step 3 grants to provide for preparing a preliminary Plan of Operation.

After construction of the project has begun, the preliminary Plan must be updated. A final Plan of Operation should be completed, submitted, and approved not later than the date by which the 50% grant payment of a Step 3 grant is made. It then will be available to the chief operator, who should be on board by that time. In that way, the Plan can serve as a guide to adequately prepare for proper start-up and operation of the treatment facility.

REFERENCES

PL 92-500, Section 204(a)(4)
40 CFR 35.935-12

ATTACHMENT A
to PRM #77-3

Basic Consideration in the Development of a Plan of Operation for Wastewater Treatment Facilities

A Plan of Operation for a new or expanded wastewater treatment facility should provide an action plan and implementation schedule to assure that all necessary actions to properly prepare for facility start-up and continued operation are accomplished in a timely fashion. The basic guidance document for the development of a Plan of Operation is Federal Guidelines - Operation and Maintenance of Wastewater Treatment Facilities, published by the EPA in August 1974. Some of the guidance needed to implement the Plan of Operation may be contained in the Operation and Maintenance (O&M) Manual prepared for the Facility. Appropriate reference in the Plan of Operation to elements of the O&M Manual may suffice for describing many specific actions. However, at a minimum the Plan of Operation must identify actions necessary to commence operations and contain an implementation schedule for their accomplishment. It is suggested that a summary of the implementation schedule be compiled on a chronological basis. This will allow easy reference on a routine basis to assure that necessary actions are initiated and completed on schedule.

The following very briefly identifies the scope of each of the areas that might be included in a Plan of Operation. The referenced Section numbers in parentheses relate to appropriate sections in the Federal Guidelines identified above which contain more detailed information on each of the areas.

1. Staffing and Training (Section 2.0)
This is a particularly important element in any plan of operation to assure that supervisory, operations, maintenance, laboratory support, and administration personnel are hired and trained in a timely manner. Sources of training should be identified whenever possible. Of particular importance is the need to have the Chief Operator on site by 50% completion of construction.

2. Records, Reports, and Laboratory Control (Section 3.0)
The establishment of an adequate laboratory, recording, and reporting system should be identified, including the development of any special forms needed for reporting or process control requirements. An special training needs related to a laboratory control program should be specified.

3. Process Control and Start-up Procedures
Adequate consideration of plant start-up is essential to assure subsequent plant operation with a minimum of problems and to set the proper framework for long-term, trouble-free, efficient plant operation under all operating conditions. The plan should identify necessary actions related to start-up, such as wet and dry testing of equipment, instrument calibration, and a review of process control procedures during start-up period. (For additional guidance on plant start-up, see PRM #77-2).

4. Safety (Section 5.0)
Effective employee safety programs should be developed and appropriate training conducted in advance of start-up. Existing and projected state and local safety requirements should be complied with. All hazardous conditions should be appraised and appropriately considered in the inplant safety and health plan and the training program should be responsive to identified needs and guidance.

5. Emergency Operating Plan (Section 6.0)
A comprehensive contingency plan for emergency operations should be included in the plant O&M manual. This plan should be substantially implemented in advance of start-up. Appropriate instructions and specific response guidance should be issued in order to minimize the possibility of plant failures under all conditions that may occur. An effective emergency response plan requires advance training in order to be effective.

6. Maintenance Management (Section 7.0)
A schedule for developing and implementing a maintenance management system should be included. This should consider the need for training to operate the system and/or to deal with complex equipment maintenance problems. Additional considerations include personnel training, supplies of chemicals used in the treatment process or process control, laboratory supplies, the provision of necessary maintenance tools and spare parts inventory.

7. Operation and Maintenance Manual
   The Plan of Operation should include sufficient lead-time for the submission and review of the plant O&M manual so as to ensure that the manual is approved by the State Water Pollution Control Agency at least 30 days prior to plant start-up. The Plan of Operation should also identify future date(s) for updating the manual in order to ensure that the most effective operational guidance is provided based upon actual operating experience.

8. Operations Budget (Section 9.0)
   Any planning process must consider budgetary constraints on implementation and provide for a process for adequate budget controls. Consideration must be given to the development and use of a user charge system; also to the availability of 10% of industrial cost recovery receipts for supporting O&M costs.

9. Other Elements
   Other elements should be addressed as necessary to assure timely implementation of actions related to continued efficient and reliable operation of the facility. Actions and timing related to the development and implementation of sewer use ordinances, pretreatment ordinances, or other local rules or regulations should also be identified. Establishment of procedures for preparing an annual O&M report should be considered for staffing, training, budget planning, maintenance, and future construction planning purposes.

The following guidance is suggested for determining the adequacy of preliminary Plans of Operation:

1. Descriptions and scheduling for elements 2-5 and 7 (above) should be essentially complete in the preliminary Plan of Operation. The staffing plan of element 1 (above) should also be complete, but the training plan may be tentative.

2. Descriptions and scheduling for elements 6, 8 and 9 (above) may be tentative in the preliminary Plan of Operation.

ATTACHMENT B
to PRM #77-3

Sample

Final Plan of Operation

Preface

Note that this "preface" is purely for descriptive purposes in setting the stage for this example of a Plan of Operation. It would not normally be included in an actual Plan.

The following material presents one example of a final Plan of Operation prepared in conjunction with the construction of a new or expanded wastewater treatment facility. This example is based upon a hypothetical situation of a new wastewater treatment facility being constructed for the City of Smithville, Pa. Smithville is a medium sized bedroom community near a large metropolitan area and has an existing secondary treatment facility. The new "Westside Wastewater Treatment Facility" is being constructed to provide treatment of wastes from a previously unsewered area recently annexed by the City, an industrial park constructed for light manufacturing industry, and housing in the same general area, and to provide treatment of some wastes from the presently overloaded facilities.

The existing facility will continue to provide treatment to the older part of Smithville. The new facility is in a size range of 5-10 mgd. The project has followed a normal procedure under the construction grant program of PL 92-500. A "preliminary" Plan of Operation would be submitted with the plans and specifications at the completion of the Step 2 facility design stage. It would differ from this example of a "final" Plan of Operation in that specific dates would not be shown because a construction timeframe has not been established. Instead, implementation could be shown either as an estimate of the percent completion of construction, or as a certain number of days before an operational start date. Also, it may not be possible to identify all necessary actions related to operations in the preliminary Plan, although it should be as complete as possible.

This example Plan of Operation is not intended as a rigid guide. Obviously, the size, complexity, and type of facility, as well as other factors, such as whether the facility is new or an expansion or modification of an existing facility, will influence the extent of information required in the Plan of Operation. It is important, however, that each of the areas illustrated in the example be considered in the Plan of Operation for any project to assure that all potential needs have been addressed. As can be seen, the intent of the Plan of Operation is clearly to provide a simple, straightforward means of identification of an implementation plan for those action items essential to successful start-up and continued operation of the treatment facility.

Introduction

This plan of operation provides an identification of needed actions and an implementation schedule for their completion to assure timely start-up and efficient operation of the new Westside Wastewater Treatment Facility now under construction in the City of Smithville, Pa. Construction of this facility began in May 1975 and is scheduled to be complete in June 1978. Adherence to the schedule contained in this Plan of Operation will help assure that start-up of the facility can be accomplished in a timely and efficient manner.

Many of the details related to necessary actions identified in this plan of operation are fully discussed in the Operation and Maintenance Manual being prepared for this facility. References to sections of that manual are included where appropriate to avoid repetition. A copy of the draft O&M manual is provided with this plan to provide necessary back-up information.

1. Summary of Implementation Dates

The implementation dates of the following sections are arrayed below in chronological order to allow rapid identification of action items and related completion dates. Frequent reference to this listing will help avoid the possibility of omission or slippage of key actions necessary for successful plant start-up and continued operation.

Date	Action	Plan of Operation Section Reference
May 1975	Start construction of treatment facility	
July 1975	Promulgate new sewer use ordinance to accommodate industrial discharges	10(a)
	Promulgate industrial pretreatment ordinance	10(b)
June 1976	FY 77 pre-start-up budget considerations	9
January 1977	Superintendent (Chief Operator) on board	2(a)
	Complete draft of O&M Manual	8(a)
	Review of user charge and industrial cost recovery systems	9
June 1977	Senior Operator on board	2(b)
	Chief Chemist on board	2(c)
	FY 78 budget consideration for initial operation	9
August 1977	Begin influent sampling program	4(a)
	Begin development of detailed emergency procedures plan	6(a)
September 1977	Begin development of detailed guidance on employee safety and related training program	5(a)
October 1977	Staff training schedule finalized and approved by State	2
January 1978	Begin development of action plan for process control and "fine tuning"	4(b)
	Begin finalization of cooperative agreements with other agencies	6(b)
	Begin specialized training on incinerator O&M	7(b)
February 1978	Shift Operators on board	2(d)
	Complete details of emergency procedures plan	6(a)

Date	Action	Plan of Operation Section Reference
February 1978 (continued)	Begin provision of laboratory supply inventory	3(b)
	Begin finalization of system and procedures for notification of unusual industrial waste discharges	4(d)
	Begin employee training in emergency procedures	6(c)
	Begin training of plant personnel on maintenance procedures	7(f)
	Finalize O&M Manual	8(b)
March 1978	Complete detailed guidance on employee safety and related training program	5(a)
	Finalize cooperative assistance agreements with other agencies	6(b)
	Start review of laboratory analytical and reporting requirements with operators and laboratory staff	3(a)
	Complete development of action plan for process control and "fine tuning"	4(b)
	Start safety training program	5(b)
	Begin debugging of maintenance management system computer software	7(c)
April 1978	Complete review of laboratory analytical and reporting requirements with plant staff	3(a)
	Complete inventory of laboratory supplies	3(b)
	Complete employee training in emergency procedures	6(c)
	Complete spare parts inventory	7(a)
	Complete specialized training on incinerator O&M	7(b)
	Start review of process control and detailed start-up procedure with plant staff	4(c)
	Begin training on maintenance management system usage	7(d)
	O&M Manual approved	8(c)
May 1978	Complete debugging of maintenance management system computer software	7(c)
	Complete training on maintenance management system usage	7(d)
	Begin pre-start-up maintenance schedule	7(e)

Date	Action	Plan of Operation Section Reference
May 1978 (continued)	Maintenance crew on board	2(e)
	Complete training in heavy metals analysis	3(c)
	Treatment facility design, construction, operation records, and as built plans completed and on file	3(d)
	Complete review of process control and detailed start-up procedures with plant staff	4(c)
	Complete influent sampling program	4(a)
	Finalize system and procedures for notification of unusual industrial waste discharges	4(d)
	Complete safety training program	5(b)
June 1978	Complete wet and dry testing of all equipment	4(e)
	Complete construction of treatment facility (Facility ready for operation)	
	Start periodic safety reviews with staff	5(c)
	Complete training of plant personnel on maintenance procedures	7(f)
June 1979	Conduct first annual plant safety review and modify safety program, if necessary	5(d)
	Initiate annual emergency procedures update and employee training program	6(d)
	Update O&M Manual	8(d)
	Complete first annual treatment system O&M report	10(c)

2. Staffing and Training

The recommended staffing complement and a suggested organizational chart is included in Section ____ of the O&M manual. In accordance with EPA guidelines, the chief operator of the facility should be on board at the 50% completion point of the construction phase of the project. The City has been notified of this requirement, and recruitment actions will begin soon.

In order to assure adequate time for familiarization with the new facility and to adequately prepare for start-up, the staff of the facility should be hired in accordance with the following schedule:

a.	Superintendent (Chief Operator) on Board	January 1977
b.	Senior Operator on Board	June 1977
c.	Chief Chemist on Board	June 1977
d.	Shift Operators on Board	February 1977
e.	Maintenance Crew on Board	May 1978

As each of the personnel is located and hired, training needs must be identified in cooperation with the State Water Pollution Control Agency. A training schedule should be finalized no later than October 1977. It is anticipated that additional training in activated sludge process control will be needed for this new facility and consideration should be given to the training courses available through the Smith County Community College.

Certain specialized training needs have been identified for this new facility and are discussed as appropriate in other sections of this plan.

3. Records, Reports and Laboratory Control

Examples of daily log sheets, State reporting forms and self-monitoring report forms to comply with NPDES permit requirements are included in Section ____ of the O&M manual. No special reporting requirements have been identified; however, certain heavy metals analysis must be included due to anticipated discharges from the Westside Industrial Park to be served by this facility.

		Start date	Completion date
a.	Conduct review of laboratory analytical and reporting requirements with operators and laboratory staff	March 1978	April 1978
b.	Provide inventory of laboratory supplies	Feb. 1978	April 1978
c.	Complete training in heavy metals analysis (identify source of training)		May 1978
d.	Treatment facility design, construction, operation records, and as built plans completed and on file in superintendent's office		May 1978

4. Process Control and Start-up Procedures

Process control and start-up procedures are detailed in Sections ____ and ____, respectively, of the O&M manual. Implementation of the actions identified in those sections should occur in accordance with the following schedule:

		Start date	Completion date
a.	Begin sampling program to define plant influent characteristics	August 1977	May 1978
b.	Develop action plan for process control and "fine tuning"	Jan. 1978	March 1978

		Start date	Completion date
c.	Review process control and detailed start-up procedures with plant operations and laboratory staff	April 1978	May 1978
d.	Finalize system and procedures for notification of unusual industrial waste discharges	Feb. 1978	May 1978
e.	Complete wet and dry testing of all equipment		June 1978

5. Safety

The need and specifics of a safety program for this facility are detailed in Section ____ of the O&M manual. Activities related to safety should be implemented in accordance with the following schedule:

		Start date	Completion date
a.	Develop detailed guidance on employee safety and related training program	Sept. 1977	March 1978
b.	Conduct training program for all plant staff prior to start-up	March 1978	May 1978
c.	Start periodic safety reviews with staff		June 1978
d.	Conduct first annual plant safety review and modify safety program if necessary		June 1979

6. Emergency Operating Plan

Detailed emergency operating procedures are outlined in Section ____ of the O&M manual. To assure success of these procedures during an emergency, the following actions should be taken:

		Start date	Completion date
a.	Develop details of emergency procedures plan including personnel assignments	August 1977	February 1978
b.	Finalize cooperative assistance agreements with other agencies	Jan. 1978	March 1978
c.	Pre-start-up employee training	Feb. 1978	April 1978

		Start date	Completion date
d.	Initiate annual procedures update and employee training program		June 1979

7. Maintenance Management

The maintenance management system for this facility is outlined in Section ____ of the O&M manual. The maintenance management system will utilize the City's computer capability to provide routine scheduling of preventive maintenance activities, spare parts inventory control, and records of running time and reliability of performance. To successfully implement this maintenance management system, the following actions must be taken.

		Start date	Completion date
a.	Complete spare parts inventory including necessary tools		April 1978
b.	Conduct specialized training on incinerator operation and maintenance by equipment supplier	Jan. 1978	April 1978
c.	Debugging of computer software by subcontractor	March 1978	May 1978
d.	Conduct training on system usage by subcontractor	April 1978	May 1978
e.	Begin pre-start-up maintenance schedule		May 1978
f.	Provide training of plant personnel on maintenance procedures	Feb. 1978	June 1978

8. Operation and Maintenance Manual

The operation and maintenance manual should be drafted, finalized, approved, and updated in accordance with the following schedule:

a.	Drafted	January 1977
b.	Finalized	February 1978
c.	Approved	April 1978
d.	Updated based on first year operating experience	June 1979

9. Operations Budget

This facility is scheduled to begin operation in June 1978. Since the hiring and training of personnel should begin in January 1977, appropriate considerations of related costs must be provided in the City's FY '77 budget.

Consideration of pre-start-up and full operation costs must be reflected in the City FY '78 budget with the first full year of operation being FY '79. The City's user charge system and rate structure should be reviewed by January 1977 to assure an adequate base to provide needed operating and maintenance revenues.

10. Other Elements

The new Westside Wastewater Treatment Facility satisfies needs of the City of Smithville that will require responsive actions. To complete pre-start-up and post-operative actions that will assure continued operational success, the following actions must also be taken in addition to those previously identified:

a.	Promulgate new sewer use ordinance to accommodate industrial discharges	July 1975
b.	Promulgate industrial pretreatment ordinance	July 1975
c.	Complete first annual treatment system O&M report including recommendations on budget, staffing, training, maintenance and repairs, and future needs.	June 1979

USE OF REVIEW OPERATION CHECKLIST

The grantee can use this checklist as well as PRM 77-3 to evaluate its plan of operation. By using the checklist and PRM 77-3 the grantee can ensure that the consultant has developed a valid plan of operation, one that can help him/her monitor the consultant's activities. The checklist follows.

PLAN OF OPERATION

REVIEW OPERATION CHECKLIST

(for Preliminary and Final Plan of Operation)

	YES	NO	NA
1. CHRONOLOGICAL SUMMARY OF IMPLEMENTATION DATES			
2. STAFFING AND TRAINING (Schedule Provided?) (Dates for implementation)			
a. Identification of personnel requirements			
b. Hiring of chief operator by 50 percent completion of construction			
c. Hiring of other operation and maintenance personnel			
d. Hiring of management personnel			
e. Identification of and provisions for training needs (basic, upgrade, and start-up)			
3. RECORDS, REPORTS, AND LABORATORY CONTROL (Schedule Provided?) (Dates, etc.)			
a. Adequate laboratory facilities completed			
b. Adequate laboratory equipment installed and supplies inventory on hand			
c. Development of laboratory testing/process control training			
d. Development of laboratory training needs defined			

	YES	NO	NA
e. Development of appropriate monitoring, sampling, and analysis program for each process			
f. Development of a program to confirm influent and effluent characteristics and removal efficiencies (suggest influent sampling begin at 50 percent completion of construction)			
g. Development of plant operating records to be filed with proper state and federal agencies			
h. Development of plant process control records			
i. Development of special forms and records			
j. Finalization of records and report systems			
4. PROCESS CONTROL AND START-UP PROCEDURES (Schedule Provided?) (Dates, etc.)			
a. To be described in operation and maintenance manual			
b. To be updated in revision of O&M manual based upon actual operation experience obtained during plant start-up period			
5. SAFETY PROGRAM (Schedule Provided?) (Dates, etc.)			
a. To be described in operation and maintenance manual			
b. Safety training to be given as a part of start-up training			
6. EMERGENCY OPERATING PLANT (Schedule Provided?) (Dates, etc.)			
a. To be described in operation and maintenance manual			
b. To be updated in revision of O&M manual based upon actual operation experience obtained during plant start-up period			
c. Emergency operation procedures training to be given as part of start-up training			

	YES	NO	NA
7. MAINTENANCE MANAGEMENT PROGRAM (Schedule Provided?) (Dates, etc.)			
a. To be described in operation and maintenance manual			
b. To be updated in revision of O&M manual based upon actual operation experience obtained during plant start-up period			
c. Maintenance management training to be given as part of start-up training			
8. OPERATION AND MAINTENANCE MANUAL PREPARATION (Schedule Provided?) (Dates, etc.)			
a. An operation and maintenance manual will be developed pursuant to Public Law 92-500 in accordance with applicable rules and regulations			
b. Operation and maintenance manual revision or update after plant has been placed in operation and plant process reaction has stabilized			
c. Instruction in operator use of O&M manual to be given as a part of start-up services			
9. SEWER MAINTENANCE PROGRAM			
10. OPERATION AND MAINTENANCE BUDGET REQUIREMENTS (Schedule Provided?)			
a. Prestart-up budget			
b. Start-up budget			
c. Identification of operation and maintenance budget by category			
1. Salaries and wages			
2. Operation			
3. Utilities			
4. Chemical (used for operational purposes)			
5. Maintenance			
6. Training			

	YES	NO	NA
7. Upgrading and raises			
8. Grounds maintenance			
9. Laboratory costs			
10. In-house contracting			
11. Outside contracting			
12. Contingency fund			
13. Total operation and maintenance budget			
d. Establishment of procedures for the preparation of an annual O&M budget report including staffing, training, budget planning, maintenance, and future construction			
e. User charge rate structure			
f. Industrial cost recovery usage for O&M budget			
11. PRETREATMENT PROGRAM DEVELOPMENT (Schedules, if required)			
12. OTHER ELEMENTS			
a. Promulgate new sewer use ordinance			
b. Promulgate industrial pretreatment ordinance			
c. Sewer system rehabilitation			
d. Development of a user charge rate structure and ordinance			
e. Development of an industrial cost recovery system and ordinance			
f. Compliance with any state/local regulations not previously addressed			

EXAMPLE OF AN ACCEPTABLE PLAN OF OPERATION

FINAL PLAN OF OPERATION

A WASTEWATER TREATMENT PLANT

PODUNK, ALLSTATE
July 1979

P. E. "Calculator" McGraw
Consulting Engineer

INTRODUCTION TO AN ACCEPTABLE PLAN OF OPERATION

The Plan of Operation submitted by P.E. "Calculator" McGraw is an example of an acceptable plan of operation. It contains many of the tasks and actions necessary to prepare the facility and all associated personnel for start-up and continued operation.

However, it would have been a better plan if it had contained the following:

1. Who will perform the tasks, and what are their qualifications?
2. How will the tasks be performed?
3. The nature of each task
4. Information on staffing and training as required by Federal Guidelines - Operation and Maintenance of Treatment Facilities, August 1975 (Reference Item #8, page R-1)
5. A means for monitoring the actions and tasks needed
6. A detailed budget and more money provided for training
7. Plant specific details, not just a carbon copy of example in PRM 77-3

This plan is acceptable because it follows the format of PRM 77-3 and contains the same information found in PRM 77-3

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8. Operation and Maintenance Manual 4-30
9. Operation Budget 4-30
10. Other Elements 4-31

INTRODUCTION

This plan of operation provides an identification of needed actions and an implementation schedule for their completion to assure timely start-up and efficient operation of the new Wastewater Treatment Facility to be built by the City of Podunk, Allstate. Construction of this facility began in September 1978 and is scheduled to be complete in October 1979. Adherence to the schedule contained in this Plan of Operation will help assure that start-up of the facility can be accomplished in a timely and efficient manner.

Many of the details related to necessary actions identified in this plan of operation are discussed in the Operation and Maintenance Manual being prepared for this facility. Reference to sections of that manual are included where appropriate to avoid repetition. A copy of the draft O&M Manual has been provided to give necessary backup information.

1. SUMMARY OF IMPLEMENTATION DATES

The implementation of the following sections are listed below in chronological order to allow rapid identification of action items and related completion dates. Frequent reference to this listing will help avoid the possibility of omission or slippage of key actions necessary for successful plant start-up and continued operation.

Date	Action	Plan of Operation Section Reference
September 1978	Start construction of treatment facility	
October 1978	Promulgate new sewer use ordinance to accommodate industrial discharges	10(a)
	Promulgate industrial pretreatment ordinance	10(a)
November 1978	Budget prestart-up costs	9
December 1978	Chief operator on board	2(a)
	Complete draft of O&M Manual	8(a)
	Review of user charge and industrial cost recovery systems	9
January 1979	Budget initial operation costs	9
February 1979	Begin influent sampling program	4(a)
	Begin development of detailed emergency procedures plan	6(a)
March 1979	Begin development of detailed guidance on employee safety and related training program	5(a)

Date	Action	Plan of Operation Section Reference
April 1979	Staff training schedule finalized and approved by state	2
May 1979	Begin development of action plan for process control and "fine tuning"	4(b)
	Begin finalization of cooperative agreements with other agencies	6(b)
June 1979	Operator on board	2(d)
	Complete details of emergency procedures plan	6(a)
	Begin provision of laboratory supply inventory	3(b)
	Begin finalization of system and procedures for notification of unusual industrial waste discharges	4(d)
	Begin employee training in emergency procedures	6(c)
	Begin training of plant personnel on maintenance procedures	7(c)
	Finalize O&M Manual	8(b)
August 1979	Complete detailed guidance on employee safety and related training program	5(a)
	Finalize cooperative assistance agreements with other agencies	6(b)
	Start review of laboratory analytical and reporting requirements with operators and laboratory staff	3(a)
	Complete development of action plan for process control and "fine tuning"	4(b)
	Start safety training program	5(b)

Date	Action	Plan of Operation Section Reference
September 1979	Complete review of laboratory analytical and reporting requirement with plant staff	3(a)
	Complete inventory of laboratory supplies	3(b)
	Complete employee training in emergency procedures	6(c)
	Complete spare parts inventory	7(a)
	Start review of process control and detailed start-up procedure with plant staff	4(c)
	Begin training on maintenance management system usage	7(b)
	O&M Manual approved	8(c)
October 1979	Complete training on maintenance management system usage	7(b)
	Begin prestart-up maintenance schedule	7(c)
	Treatment facility design, construction, operation records, and as-built plans completed and on file	3(d)
	Complete review of process control and detailed start-up procedures with plant staff	4(c)
	Complete influent sampling program	4(a)
	Finalize system and procedures for notification of unusual industrial waste discharges	4(d)
	Complete safety training program	5(b)
November 1979	Complete wet and dry testing of all equipment	4(e)
	Complete construction of treatment facility (facility ready for operation)	

November 1979 (continued)	Start periodic safety reviews with staff	5(c)
	Complete training of plant personnel on maintenance procedures	7(d)
October 1980	Conduct first annual plant safety review and modify program, if necessary	5(d)
	Initiate annual emergency procedures update and employee training program	5(d)
	Update O&M Manual	8(d)
	Complete first annual treatment system O&M report	10(c)

2. STAFFING AND TRAINING

The recommended staffing complement is included in the O&M Manual. In accordance with EPA guidelines, the chief operator of the facility should be on board at the 50 percent completion point of the construction phase of the project.

In order to assure adequate time for familiarization with the new facility and to prepare adequately for start-up, the staff of the facility should be hired in accordance with the following schedule:

a.	Chief operator on board	December 1978
b.	Operator on board	June 1979

As personnel are located and hired, training needs must be identified in cooperation with the State Water Pollution Control Agency. A training schedule should be finalized no later than April 1979. It is anticipated that additional training in activated sludge process control will be needed for this new facility and consideration should be given to the training courses available through Allstate A&M University.

Certain specialized training needs have been identified for this new facility and are discussed as appropriate in other sections of this plan.

3. RECORDS, REPORTS, AND LABORATORY CONTROL

Examples of daily log sheets, state reporting forms, and self-monitoring report forms to comply with NPDES permit requirements are included in Section IX of the O&M Manual. No special reporting requirements have been identified.

		Start Date	Completion Date
a.	Conduct review of laboratory analytical and reporting requirements with operators and laboratory staff	August 1979	September 1979
b.	Provide inventory of laboratory supplies	June 1979	September 1979
c.	Treatment facility design, construction, operation records, and as-built plans completed and on file in superintendent's office		October 1979

4. PROCESS CONTROL AND START-UP PROCEDURES

Process control and start-up procedures are detailed in Section VI of the O&M Manual. Implementation of the actions identified in that section should occur in accordance with the following schedule.

		Start Date	Completion Date
a.	Begin sampling program to define plant influent characteristics	February 1979	October 1979
b.	Develop action plan for process control and "fine tuning"	May 1979	August 1979
c.	Review process control and detailed start-up procedures with plant operation and laboratory staff	September 1979	October 1979
d.	Finalize system and procedures for notification of unusual industrial waste discharges	June 1979	October 1979
e.	Complete wet and dry testing of all equipment		November 1979

5. SAFETY

The need and specifics of a safety program for this facility are detailed in Section X of the O&M Manual. Activities related to safety should be implemented in accordance with the following schedule:

		Start Date	Completion Date
a.	Develop detailed guidance on employee safety and related training program	March 1979	August 1979
b.	Conduct training program for all plant staff prior to start-up	August 1979	October 1979
c.	Start periodic safety reviews with staff		November 1979
d.	Conduct first annual plant safety review and modify safety program if necessary		October 1980

6. EMERGENCY OPERATING PLAN

Detailed emergency operating procedures are outlined in Section XI of the O&M Manual. To assure success of these procedures during an emergency, the following actions should be taken:

		Start Date	Completion Date
a.	Develop details of emergency procedures plan including personnel assignments	February 1979	June 1979
b.	Finalize cooperative assistance agreements with other agencies	May 1979	August 1979
c.	Prestart-up employee training	June 1979	September 1979
d.	Initiate annual procedures update and employee training program		October 1980

7. MAINTENANCE MANAGEMENT

The developed maintenance management system for this facility is outlined in Section X-I of the O&M Manual. The maintenance management system provides routine scheduling of preventive maintenance activities, spare parts inventory control, and records of running time and reliability of performance. To implement this maintenance management system successfully, the following actions must be taken:

		Start Date	Completion Date
a.	Complete spare parts inventory including necessary tools	--	September 1979
b.	Conduct training on system	September 1979	October 1979
c.	Begin prestart-up maintenance schedule		October 1979
d.	Provide training of plant personnel on maintenance procedures	June 1979	November 1979

8. OPERATION AND MAINTENANCE MANUAL

The operation and maintenance manual should be drafted, finalized, approved, and updated in accordance with the following schedule:

a.	Drafted	December 1978
b.	Finalized	June 1979
c.	Approved	September 1979
d.	Updated based on first year of operating experience	October 1980

9. OPERATION BUDGET

Appropriate considerations of related costs must be provided in the city's budget. Consideration of prestart-up and full operation costs must be reflected in the first full year of operation. The city's user charge system and rate structure should be reviewed to assure an adequate base to provide needed operating and maintenance revenues.

ESTIMATED BUDGET FOR FIRST YEAR OF OPERATION

Salaries:

Chief Operator
Assistant Operator
Laboratory Technician and Operator
Laborer

Total Salaries	$ 34,200.00
Utilities	36,700.00
Chemicals (Chlorine)	4,500.00
Chemicals (Laboratory)	2,400.00
Maintenance	22,775.00
Training	425.00
Total	$101,000.00

10. OTHER ELEMENTS

The new Wastewater Treatment Facility satisfies the needs of the City of Podunk, Allstate. It will require responsive actions to complete prestart-up and postoperative activities that will assure continued operation success. The following actions must be taken in addition to those previously identified:

a.	Promulgate new sewer use ordinance to accommodate industrial discharges	October 1978
b.	Promulgate industrial pretreatment ordinance	October 1978
c.	Complete first annual treatment system O&M report including recommendations on budget, staffing, training, maintenance and repairs, and future needs.	October 1980

NOTE: This is only an example; each plan of operation must be plant specific.

UNIT FIVE

ELEMENTS OF A GOOD O&M MANUAL

OUTLINE

I. O&M MANUAL DEVELOPMENT 5- 2

  A. Why is an O&M Manual Prepared?
  B. When is an O&M Manual Prepared?
  C. Who Prepares the O&M Manual?

II. BE AWARE OF OPERATOR NEEDS 5-10

  A. Scope
  B. Format
  C. Writing Style
  D. Reading Level

III. O&M MANUAL QUALITY EVALUATION REPORT 5-23

IV. O&M MANUAL REVIEW OPERATION CHECKLIST 5-24

OBJECTIVES

Following the Unit Five presentation, the participant will be able to:

1. Determine operator needs in an O&M manual as related to scope, format, writing style, and reading level
2. Describe and discuss the need for preparing an O&M manual
3. Discuss the use of the O&M manual and the operation review checklist

O&M MANUAL DEVELOPMENT

Why Is An O&M Manual Prepared?

When a wastewater treatment problem has been carefully studied, several solutions are considered. The final solution is selected after evaluating all of the alternatives. The facility is then designed to treat the wastewater pollution problems. This design is based upon influent characteristics and the desired effluent quality.

WE NEED AN O&M MANUAL!!
WHY?

The designer has specific objectives for each unit and each process of the treatment facility. These design objectives can be achieved only if the plant operator and owner know and understand the design objectives and effectively operate the wastewater treatment plant to meet them. Using a properly prepared O&M manual is the most effective way of informing the plant operator and owner of the designer's objectives.

An O&M manual is a document that provides necessary instruction to operating personnel while listing the daily tasks necessary to achieve these objectives. The manual must explain the reason for the system, identify each unit and its function, and tell how each unit's performance affects the performance of all other units in the system. From this explanation, the operator will understand the system and better understand the need to operate the plant as a unified system to achieve optimal performance.

The manual must clearly explain the operator's responsibilities and duties: operating and maintaining the treatment plant to continuously achieve high effluent quality within the budget limitations set by the plant's owner. It must explain the plant process and provide overall process control guidance. In addition, the manual should explain the daily routine procedures needed to ensure proper plant performance. The guidance and daily routines must be incorporated into an overall operation and maintenance system and plan to ensure that all tasks needed for proper O&M are completed correctly.

The O&M manual is a reference manual to be used by plant operation and maintenance personnel as a guide in keeping the treatment plant operating effectively. It fully describes the plant and its functions. The O&M manual is also designed as a training manual to be used as a study guide during the training of plant operating personnel during start-up and start-up training.

The preliminary draft of the manual may be used in the training if the manual is not in its final form. There are many side benefits of using the draft O&M manual for training. It can be determined if the operators can read and understand the manual by having them review and give feedback on the contents of the manual. Operator needs which have been overlooked in the draft O&M manual can be identified and included in the final O&M manual. Early evaluation of the manual by the intended users allows time to revise the manual to fit the operator's needs.

The contractor uses the O&M manual to help understand the plans and specifications. The manual explains the treatment facility and how it works. This helps ensure that the treatment works is constructed to meet the design criteria. If the contractor and his/her personnel understand the equipment used, its performance characteristics, and its performance requirements, they can position and install the equipment better. Equipment should be accessible to O&M personnel since they must service the equipment and read gauges or meters.

The O&M manual may be used as a design tool. The design has a goal or objective for each piece of equipment to be used in the treatment plant. To achieve design criteria, each unit must function as the designer intended. The designer will be aware of all actions that must be taken to operate and maintain the equipment if the manual is used in the design phase. By remembering that people are going to operate and maintain the wastewater facility, the designer will keep in mind what has to be done and the easiest and most efficient way to do it. A comparison of the O&M manual to the plans and specifications by the designer and the reviewer will help ensure the planning and building of an operable plant.

There are numerous individuals who need an O&M manual.

The facility owner has a definite need for the O&M manual because it tells the owner what he/she is buying and his/her continuing responsibilities for the operation and maintenance of the treatment facility. The owner's most pressing needs are those of personnel, staffing, training, and O&M budgeting. The O&M manual includes:

1. Cost of O&M budgeting
2. Personnel (how many, their skills, when to hire, and what training will be provided)
3. Available training or where to go for training information

The plant superintendent needs to know what type of O&M program the new facility needs for continuous operation and maintenance. From the O&M manual, the plant superintendent will be able to determine what must be done and when to implement an effective O&M program. Staffing and training needs will be identified. A maintenance management program can be developed as equipment is installed so it will be maintained in accordance with warranty requirements.

In many instances it is not the design engineer but the resident engineer who is responsible for overseeing the construction of the treatment plant. The O&M manual can aid in approving equipment location and installation, evaluating needs for change orders, and evaluating construction in terms of operability and maintainability. The resident engineer will probably be responsible for start-up and start-up training and should use the draft O&M manual as a training aid. By using the draft manual the design engineer can help revise and update it. Using the manual will give the resident engineer an understanding of the design goals, thus helping to ensure a properly functioning treatment facility that O&M personnel can operate correctly.

The O&M manual is a legal requirement for state and federal agencies. It must be reviewed and approved by the appropriate regulatory agency. During the review process, the reviewer should look at all documents from the operator's point of view. The O&M manual will help in the review, approval, and monitoring of the required plan of operation. This ensures that all requirements for future operations have been planned for in a timely manner. If the reviewer has a complete awareness and understanding of the proposed wastewater treatment facility, including the design objectives, the review process will be more effective.

If the design engineer develops the appropriate sections of the manual as the project progresses, the design will be improved because operation and maintenance requirements were considered throughout the design process. The design engineer can use the O&M manual to check the plans and specifications. This ensures that process and equipment flexibility have been included in the design. Good operational guidance is provided to operating personnel if the O&M manual is developed at the same time the design is developed. The design engineer can use the O&M manual to:

1. Aid in quick review and approval of project
2. Convey ideas and concepts to review personnel and facility owners
3. Assure that resident engineers and contractors do their jobs

Most importantly, if the design engineer has paid close attention to O&M details in the design and has documented the correct O&M procedures then the O&M manual will be a useful guide for plant O&M personnel.

There are many people who need and use an O&M manual. If the manual is prepared properly it can be used by all parties concerned with the wastewater treatment facility. Each user has different needs and uses for the O&M manual. The needs of each user will be met if the format and language level are directed to these needs.

When Is An O&M Manual Prepared?

The regulations state:

> "The Regional Administrator shall not pay (1) more than 50 percent of the Federal share of any Step 3 project unless the grantee has furnished a draft of the operation and maintenance manual for review, or adequate evidence of timely development of such a draft, or (2) more than 90 percent of the Federal share unless grantee has furnished a satisfactory final operation and maintenance manual."

Interpretation of item (1) differs from EPA region to region and from state to state within the region. Unfortunately, the phrase "evidence of timely development" is used to obtain the 50 percent payment even when noticeable progress has not been made toward the development of the O&M manual. All regions and states require approval of the final O&M manual prior to final payment.

O&M manual preparation should begin early. If the design engineer waits until Step 3 many benefits of early O&M manual preparation are forfeited. The use of the O&M manual as a design tool is lost. The designer may not be able to correct design deficiencies during the design phase. Instead (since the plans and specifications are already approved) the time-consuming and costly change order procedure must be used. Sometimes it is too late to make change. As a result, many changes that could make the facility more operable, flexible, and reliable in meeting effluent standards are not incorporated into the facility design.

O&M manual preparation should begin at the same time the facility plan (Step 1 grant) is being developed. Much of the information included in the facility plan is also included in the O&M manual. The appropriate sections (permit and standards, personnel, laboratory testing, utilities, emergency operating plan) could be prepared to serve dual functions of meeting the facility plan and the O&M manual requirements. Since the facility plan is an engineering report, some editing and format changes would be needed. However, the changes needed could be minimized if the sections are prepared for maximum dual use.

The preparation of the O&M manual should begin no later than the preparation of the plans and specifications. In preparing plans and specifications, the design engineer designs the entire wastewater treatment plant in detail. The design engineer must assure that flexibility has been considered to the utmost in the design by considering all requirements for pipes, gates, meters, valves, flow channels, etc. If a description of each step envisioned by the design engineer for facility operation was prepared and explained at this time and an explanation was given of why each unit was included, then the process controls and operational procedures of the O&M manual for the facility would practically be written. The process controls and operation procedures will need to be finalized when specific equipment is selected and installed.

Developing the O&M manual concurrently with the plans and specifications will identify unique operational requirements. This enables the designer to develop specifications accordingly, results in tighter and better specifications, and assures that design and operational requirements are met.

During preparation of plans and specifications some portions of the O&M manual can be completed, such as schematic drawings and the O&M budget. The plans and specifications should require that shop drawings and equipment specifications be forwarded from equipment manufacturers to the consultant at the time equipment is ordered. This will allow early development of a detailed O&M manual.

Prior to the construction phase, most of the O&M manual should be completed. Final touches can be made during construction to ensure that the final manual reflects "as-built" conditions. Editing for operator readability and the addition of more detailed information produces a readable and usable manual.

When the final O&M manual has been drafted, submitted, and approved, payments beyond the 90 percent payment request can be made. The O&M manual requirement has not been met until the manual has been tested, carefully reviewed, and updated after plant start-up and operation. Any defects should be noted and corrective action taken. An O&M manual must be subject to change if it is to be a useful reference.

O&M
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Who Prepares the O&M Manual?

The O&M manual should be prepared by the best qualified personnel. Is this the design engineer, the resident engineer, the operator, an outsider, or a separate staff in the consulting firm? All of these have prepared manuals with varying degrees of success. The O&M manual should include input from more than one source. The design engineer, the resident engineer, the superintendent, and the operator should be involved in O&M manual preparation.

Having been with the project from the beginning, the design engineer understands the process best. The design engineer comprehends the performance objectives. He/she should incorporate operation and maintenance requirements into the design and should prepare the overview portions of the O&M manual.

The resident engineer must contribute to the manual because he/she has been onsite and knows the arrangement of the facility. The resident engineer will ensure that the O&M manual reflects "as-built" conditions of the facility. During construction each system must be evaluated for operability and maintainability. The resident engineer must identify and implement any changes in the plans and specifications that are needed to improve O&M. The engineer will also be involved in the scheduling and implementation of the plan of operation. Input from the resident engineer is a requirement to assure that prestart-up and start-up requirements are included in the O&M manual. The resident engineer may not write the manual, but his/her input will be an invaluable resource to the writer.

The plant superintendent is one of the users of the O&M manual and should review its drafts. If the superintendent or maintenance and administrative personnel cannot read or understand the manual, then editing and revising the format are necessary. The author of the O&M manual should use the plant superintendent as a proofreader. This ensures readability and the inclusion of necessary information.

When possible, the operator should be consulted by the O&M manual author and should review the sections he/she will use. The manual cannot be used by the operator if he/she cannot read or understand it. Therefore, when preparing an O&M manual the operator should be used as a resource.

An O&M manual is prepared to communicate ideas, concepts, and facts to the plant operation and maintenance staff. Communication of information must be the author's first objective. The writer must identify the audience and write the objectives in terms of what the audience will be able to do.

BE AWARE OF OPERATOR NEEDS

Scope

The manual should contain useful information for the plant operation and maintenance personnel. The writing style and format should be easily understood by the operator. Any data not directly related to facility operation and maintenance should be summarized in the appendices of the manual.

BE
ON
TARGET!!

As a minimum the manual should contain:

1. Design summary
2. Industrial wastes and their effects
3. Troubleshooting
4. An introduction
5. A permit and standards section
6. Simple instructions on how to operate and control the wastewater treatment facilities and each unit within, including sludge treatment and handling
7. A description of personnel requirements
8. A laboratory testing section
9. A records section
10. A maintenance management section
11. An emergency operation and response program
12. A safety program
13. A utilities section including electrical power sources
14. Appendices of helpful information including EPA manuals and documents (as applicable)

The introduction or overview should introduce the entire wastewater treatment system to the operator. It should present broad concepts of the treatment system and introduce the treatment plant's overall performance objectives. This section should describe the type of waste treated and its sources and the sewer system and its possible problems. This description should not be lengthy, but should inform the operator of the type of raw wastewater that will be treated and how to cope with sewer system-induced problems.

The overview should describe the wastewater treatment process in great detail. It should: 1) cover flow patterns for both solids and liquids in the plant, 2) identify and explain different components and processes in the treatment of wastewater and sludge, and 3) state the performance objectives for each unit. The design engineer should explain why the particular treatment sequence was chosen over other alternatives. The overview must stress the importance of operating the treatment facility as a complete system rather than operating individual units and explaining how each unit process works and its relation to other processes. The operator must realize the importance of keeping each component functioning properly if the treatment plant is to achieve its performance objectives.

Operational flexibility, including flexibility of flows and modes of operation, should be covered in the overview. It should be stressed that operational flexibility can be used to maintain a consistently high quality of effluent.

In order to ensure continuous and effective plant operation, the overview should also include the operator's goals and responsibilities. The purpose of these goals and responsibilities should be included in this section. The operator's importance as a water quality and health protector must be stressed. In addition, the overview should briefly discuss the regulations, permits, and standards that apply to the treatment facility. These should be presented in a manner that establishes compliance with permits, standards, and regulations for proper and effective operation and maintenance.

The permits and standards section is written for the plant operator, but city officials and the public should be considered when writing this section. This section can be used to convey the importance of plant operation and maintenance staff and the need for continuous upgrading of operating skills through training.

The manual must explain each unit process in terms of operation, process control, and maintenance, which is perhaps the most important part of the O&M manual. The explanation of each unit process given in the overview is expanded in this section to include:

1. Process description
2. Operation principles
3. Process control procedures
4. Preventive maintenance
5. Process troubleshooting
6. Emergency operation and maintenance

A complete description of the process must be given including process characteristics and how they relate with other processes. A schematic of the processing unit with three-dimensional drawings showing piping of all flows and utilities should be included. Several drawings may be needed. All related equipment (pumps, gauges) should be described in detail. The impact of improper unit operation on the other processes should be emphasized.

Explanation of operation principles is important so the operator will know what is to be done, how it is to be done, and why it is done.

The O&M manual should include in the appendices background and theory that is easily understood by the operator. This promotes correct operation and control of the process. Additional references, which contain a complete and detailed explanation of the theory of wastewater treatment, can be provided in the appendices to the O&M manual. It is imperative that the operator understand wastewater treatment principles in order to operate the treatment facility properly and effectively.

One of the operator's most important duties is process control. This section of the O&M manual must be carefully prepared and should be as complete as possible. The operational procedures should be described in great detail. It is important to present process objectives in simple, understandable terms to achieve operator understanding. Specific data for each process objective should be presented in a step-by-step procedure for proper operation of the process. Process control guides must include a detailed description of the characteristics of a properly operating system. This includes laboratory characteristics resulting from sampling and testing and the sensory observations by the operator. This information will help the operator to determine if the process is operating properly.

The process control description should include a section on troubleshooting which contains the following:

1. Problem indicators
2. Probable causes
3. Determination of the cause by sampling, testing, monitoring
4. Corrective actions
5. Cross-reference to other sections in O&M manual
6. References if required

This guide will assist the operator in recognizing a problem and determining the necessary corrective action.

The manual should include a step-by-step description of routine maintenance procedures for each process. Tasks that can be accomplished by the staff should be identified as well as tasks that should not be accomplished. The manufacturer's literature should be included only if it meets the operator's needs. The writer should extract data that covers the equipment used in the facility. This information should be bound separately for reference. This section should also describe and discuss emergency operating and maintenance procedures for each process. The information in the maintenance section should be easily understood by the operator.

The O&M manual should include the following information on personnel:

1. Staffing plan for facility
2. Work organization plan
3. Shift and weekend staffing schedules
4. Organizational structure

An essential part of the personnel section is a training plan. All training needs must be identified. The training budget should as a minimum be equal to a sum of three to seven percent of the total O&M budget. In some instances the training requirements will require even a larger percent of the budget.

TRAINING
GOOD
O&M

There should be a section on laboratory requirements which explains laboratory needs, personnel requirements, and types of sampling, testing, monitoring programs, and quality assurance. All process control and monitoring

(NPDES) tests should be explained in a step-by-step procedure, using the Water Pollution Control Federation Manual of Procedures #18, or other appropriate material, bound separately for reference. Sampling procedures should be explained. One common weakness in this section is the absence of explanations of results. Although operators may be able to run the control test, the procedure is wasted if they do not know what the results mean. The operator must recognize the need to compare the test results to other tests. The benefits of the use and interpretation of trend charts should be discussed in the O&M manual. The value of using process control test results to improve plant efficiency must be stressed. A complete record of the test results should be kept.

Another section of the O&M manual explains the facility records and recordkeeping system. Laboratory results are a small part of the records needed at a treatment plant. The records that are kept depend upon operation and maintenance requirements and legal requirements. All necessary forms should be identified and included in the manual.

The wastewater treatment facility needs to have a maintenance management system. The manual should describe and explain the existing system or the system recommended for the facility in terms that can be understood by the plant operator. The benefits of a preventive maintenance program must be pointed out. The operator must be aware of the need to perform all routine and preventive maintenance functions on a regular basis. The manual should include a checklist of maintenance tasks, and instructions on when, how, and how often they must be accomplished.

Emergency operation procedures should be discussed in various sections of the O&M manual. The manual must contain an emergency response program which anticipates a variety of emergency situations and presents a response action for each possible situation. There are several EPA publications which provide guidance on developing emergency response programs. The manual should include training pro-

grams on dry runs which are needed to inform the operator of the emergency response program and his/her responsibilities.

An important section of the O&M manual is safety. The wastewater treatment industry has a very poor safety record. An aggressive, effective safety program must be emphasized in the O&M manual. Even though information on safety is interwoven throughout the manual, a safety section is necessary. The manual should establish safety procedures for all operation and maintenance procedures performed. It should list, describe, and explain the use of all required and/or needed safety equipment. A safety training program should also be included in the O&M manual.

The O&M manual must contain a utilities section with a separate discussion of the complete system. The description should include location (wire size, pipe size, etc.), routine maintenance, and responsibilities of plant staff or outside contractor. This section should include emergency or alternate utilities which need to be identified and located. The manual should describe equipment that is and is not connected to the emergency or alternate utility. All procedures involved in changing from the normal utility system to the emergency system must be described in a step-by-step manner.

Finally, the O&M manual should contain appendices which include all material that may be useful to the plant operator, such as:

1. Instrumentation, electrical, mechanical, and process schematics
2. The useful life expectancy of each unit
3. A line diagram of all piping

This material is usually more detailed and complex than the manual itself.

The EPA's publication Consideration for the Preparation of Operation and Maintenance Manuals (Reference Item #1, page R-2) provides extensive guidance on the contents of an O&M manual. An outline for an O&M manual is included in this document (pages 14 through 38). In addition, it contains extended notes and comments on each suggested chapter of the O&M manual. The appendices contain some excellent reference documents that can help the grantee fulfill the O&M requirements. Use of this document will help the developer prepare a usable O&M manual that meets the requirements. Each chapter of the O&M manual is covered by this document. Detailed discussions on the types of information required for each section of the O&M manual will be found in this document.

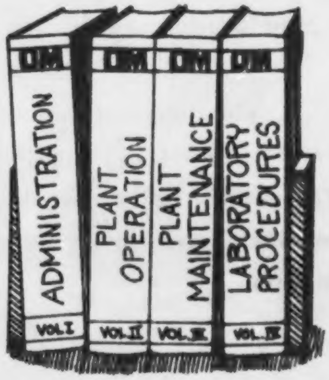
Each manual must be tailored to the individual wastewater treatment plant. If it is not, it should be rejected by the applicant.

Format

The preparation of the O&M manual for a wastewater treatment facility is of great importance, and much effort has been exerted by EPA on how it should be prepared. The primary function of the wastewater treatment facility is to collect and treat wastewater to meet regulatory requirements. The use of an O&M manual cannot be overemphasized in achieving continuous effective plant operation. The O&M manual should be developed according to the guidelines contained in Considerations for the Preparation of Operation and Maintenance Manuals (Reference Item #7, page R-2). The author must consider the audience and their needs. The manual must be adaptable for future plant enlargement and upgrading. It must be a changing document to reflect actual operating experiences. The reading level and format, as well as the included information, must meet the needs of the user and the operator.

The manual should include provisions for assuring proper and efficient operation and maintenance of the treatment facility after construction. It should also contain a complete table of contents which will assist the operator in locating information quickly.

From the operator's point of view, the manual should be divided into at least four volumes. Each volume would cover a specific topic and be bound in a three-ring binder: administration, plant operation, maintenance, and laboratory procedures. The operator should review the proposed manual. If it is not comprehensible to him/her, it should not be accepted.



The first section should be administration. This section would include an introduction, requirements and/or responsibilities of management, staffing personnel, operator training, public relations, permits and standards, safety, budget and costs, and an emergency operating and response program. This section would mainly be for administrative personnel, but should also be available to plant operation and maintenance personnel.

The next section should cover plant operation. It must describe the operation of each process as it relates to the entire system. Operational procedures for common and unexpected problems should be described in a step-by-step procedure. The control process as well as the process control test should be covered in detail, yet should be easily understood by the operator.

A section on maintenance should include detailed information on planning and scheduling, preventive maintenance programs, an equipment records system, a parts inventory system, lubricants and housekeeping, and maintenance personnel requirements. The various parts of this section must be explained fully in a format that the maintenance personnel can understand.

The last section will contain information on laboratory procedures. This section should include a detailed description of the sampling, testing, monitoring, records, reports, and personnel requirements. It should also include information on interpretation of test results. An explanation of the value of a data analysis sheet for determining trends is needed. This section should inform the operator of the type of results expected from testing as well as specific observations expected of the treatment process.

In addition, the O&M manual should include a simplified diagram of all piping, valves, and controls, including enlarged detailed drawings of complicated piping areas. In many instances, pictures should be included.

The manual should contain flow diagrams of the treatment plant for wastewater flow, gas, sludge, water chlorine, potable water, etc. The manufacturer's daily, weekly, and monthly maintenance schedules should be summarized and cross-referenced to the page or pages of the manufacturer's manual.

There are numerous problems with O&M manuals ranging from format to lack of detail. Many manuals do not provide the necessary data for the operator to operate the wastewater treatment plant. Authors and reviewers of O&M manuals often do not consider the needs of the operator. The operator should be able to use the manual as a reference on process control, maintenance procedures, troubleshooting, operating instructions on all equipment (pumps, motors, etc.), laboratory procedures, orientation to the plant, and as a training tool. Many O&M manuals do not meet this operator need. Even when it is met there are usually other problems that the operator faces in using the manual.

Some common operator problems with the manual are: use of complex language, absence of instruction, presentation of theory only, poor format, and lack of availability.

Many manuals are too complex for the operator. Operation and maintenance manuals are written, reviewed, and approved by engineers. Since many operators have less than a high school education, the language may be too complex for them. Some have had operator training, but others have not. The language used in an O&M manual must be simple, clear, and instructive to assist the operator in learning about the treatment plant. Any technical words or expressions must be clearly defined. Manuals should be written with step-by-step procedures for the performance of all operation and maintenance tasks.

Example: The following paragraph was simplified by using the principle of listing to identify key points.

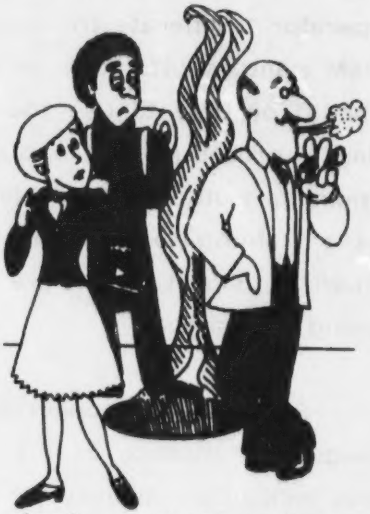
Before:

Anyone entering a manhole or other potential methane atmosphere should ventilate the area before entering. This can be accomplished by simply uncovering the area and allowing natural ventilation; however, forced-air ventilation may be required. In no event should smoking be permitted in or around sewers, pretreatment areas, sludge digesters, settling tanks, manholes, or lift stations.

After:

Before entering a manhole or other area that may have methane gas:

1. Ventilate area
   - a. Uncover
   - b. Allow natural ventilation
   - c. Use forced ventilation if necessary
2. Do not allow smoking around:
   - a. Sewers
   - b. Pretreatment areas
   - c. Sludge digesters
   - d. Settling tanks
   - e. Manholes
   - f. Lift stations



Example: Sentences should be written in a simple, easy-to-understand form.

Before:

Putrescirble substance serves as a growth mechanism for microorganisms which propagate in an oxygen atmosphere. The quantified amount of O_2 to be consumed by these aerobic bacteria can be interpreted by a physiochemical analysis called biochemical oxygen demand.

After:

Organic matter serves as food for bacteria which grow when oxygen is present in the water. These bacteria are called aerobic bacteria because they need oxygen to live. The amount of oxygen used by the aerobic bacteria to eat a given amount of organic matter can be measured by a test called biochemical oxygen demand (BOD).

In many instances the manuals are too lengthy, which causes the operator to lose interest. The operator must be able to relate to the contents of the manual. The manual must be written for the specific wastewater treatment facility in which the operator works. General information and theory should be minimized and placed in a separate section from the operating data.

For plant operation and maintenance personnel to find the necessary information, the manual must be indexed. Tabs on each section and subsection are helpful in locating information.

Availability of O&M manuals is another problem faced by plant personnel. Sometimes the manual is in the superintendent's office or other inaccessible location. If the manual is not available, it cannot be used. This can be solved by providing several copies for each facility or providing smaller "pocket-sized" copies that are readily available to the user.

Through better communication with plant operation and maintenance personnel, engineers can produce a manual that is understood and used by everyone. The manual must be tailored to a specific plant and its equipment. The O&M manual is a reference book and must be flexible. It must be changed and updated as time passes.

Having a good usable O&M manual will not always ensure continuous satisfactory plant performance. Without qualified operators, the manual has little value.

PREPARATION OF A USABLE O&M MANUAL REQUIRES ONGOING COMMUNICATION BETWEEN THE ENGINEER AND THE OPERATOR.

Writing Style

Prior to writing the manual, the author should answer several questions:

1. Who will use the O&M manual?
2. What does the user need to know?
3. How can the information be communicated effectively?

The answers to these questions should enable the author to write an O&M manual that is understandable and useful.

The target audience for the O&M manual must be identified. Their educational level, qualifications, skills, and backgrounds must be taken into consideration by the author.

The contents of each section of the manual will depend upon the needs of the user. The manual will be used primarily as a handbook of job procedures. It is important, therefore, that reading levels of the users are identified. The O&M manual must be read and understood by the user for proper operation and maintenance to be achieved.

Reading Level

There are many ways to improve the readability and usability of the O&M manual. One of the best ways is to simplify the language. The author must consider two vocabularies when writing an O&M manual: technical and general.

A technical vocabulary includes words and terms of a technical nature which are common to the wastewater field. These words and terms should be carefully defined the first time they are used in the manual.

A simplified reading level can be achieved without any loss of technical details or information. Efforts to simplify the vocabulary are time-consuming but necessary. There are several word lists that can be used as a guide to predict the readability of an O&M manual. The author should obtain one of these lists when writing the O&M manual.

One example is the Clarence R. Stone Revision of the Dale Word List which contains approximately 1,000 words. It may be obtained from the education department at most libraries. According to Stone, these words are easily recognized by 80 percent of all fourth graders. The list was developed as an overall statistical device that can give a reliable prediction of the readability level. Using this list as a guide, the author can determine the level of readability by determining the percentage of words used in the O&M manual that are on the list. The higher the percentage the more readable the manual. This list and others can serve as a guide when writing O&M manuals.

Simplifying language is one way of improving readability in O&M manuals. In addition, the author should use simple sentence structure. Even the simplest vocabulary is difficult to read when long complex sentences are used. Complex sentences usually contain multiple ideas or concepts, while simple sentences contain one basic thought. Variety can still be achieved through the use of simple sentences, but readability levels will be improved.

The use of illustrations (diagrams, charts, graphs, pictures, etc.) will clarify and simplify written information. The text must be correlated to specific illustrations. In addition, each section of the manual should pertain to one particular subject.

The table of contents, index, and appendices make the manual more usable and enable the user to locate information easily. This greatly influences usability. A subject index in the appendices is also helpful.

A reference list should be furnished as part of the O&M manual. It should contain a list of publications from the Water Pollution Control Federation, EPA, state agencies, and other sources specifically related to the operation and maintenance of wastewater treatment facilities.

The O&M manual is the operator's principal source of technical information on the operation and maintenance of the wastewater treatment facility. The manual must be tailored to each plant and should be easy to read, brief, and concise. It should be cross-referenced to the appendices and references for additional information. In terms of overall performance of wastewater treatment facilities, the O&M manual is readily available and is easy to read and use. Its routine use will help ensure proper and efficient operation and maintenance of the wastewater treatment plant.

The grantee should conduct a review of the O&M manual to ensure that it is usable. In conducting this review, the grantee should utilize the O&M Manual Quality Evaluation Report and O&M Manual Review Operation Checklist which follows.

O&M MANUAL QUALITY EVALUATION REPORT

During the review for quality evaluation the reviewer shall make comments on the following:

- **a. Language:**
- **b. Adaption:**
- **c. Sections:**
- **d. Materials for Inclusion:**
- **e. Scope of Manual:**
- **f. Updating the Manual:**

O&M MANUAL REVIEW OPERATION CHECKLIST

(For Preliminary and Final O&M Manual)

YES NO NA

1. For Step 3 grants, was draft submitted by 50 percent payment point? ___ ___ ___

2. For Step 3 grants, will final O&M manual be approved by 90 percent payment point? ___ ___ ___

3. For Step 3 grants, will O&M manual be updated under start-up subagreement/contract? ___ ___ ___

4. Is draft/final O&M manual clearly and simply written? ___ ___ ___

5. Does draft/final O&M manual incorporate (at no or nominal cost to grantee) sections from EPA technical manuals and other available references? ___ ___ ___

6. Is draft/final O&M manual in looseleaf form, organized in a logical sequence, indexed, and cross-referenced to encourage use, refining, and updating? ___ ___ ___

7. Detailed review of the O&M manual.

   Note: This section is presented in an outline form as an aid to the reviewer.

   Does the O&M manual contain the following:

   I. AN INTRODUCTION AND MANUAL USER GUIDE

      A. Operation and Managerial Responsibility

         1. Operator responsibilities defined ___ ___ ___

         2. Manager responsibilities defined ___ ___ ___

         3. List of available training ___ ___ ___

         4. List of recommended publications ___ ___ ___

         5. List of publications furnished to the facility ___ ___ ___

      B. Process Type Description

         1. Type of treatment process

            a. Brief description of major process ___ ___ ___

		YES	NO	NA
b.	Brief description of individual units			
2.	Flow pattern with diagram			
II.	PERMITS AND STANDARDS			
A.	Treatment Requirements/Effluent Limitations			
B.	List of Permits Affecting Facility (including NPDES, Corps of Engineers Section 10/404, etc.)			
1.	Permit number and renewal date			
2.	Permit requirements/regulations of permitting agency			
3.	Reporting procedure for spills			
C.	State Water Quality Standard For Receiving Stream			
III.	DESCRIPTION, OPERATION, AND CONTROL OF PROJECT FACILITIES			
A.	For Each Unit Process, General Coverage of the Following:			
1.	Description, function, flow routing, and design efficiency			
2.	Listing of major components and mechanical equipment			
3.	Relationship to adjacent units			
4.	Methods of control			
5.	Discussion of common operating problems and control			
6.	Start-up procedures			
7.	Emergency shutdown procedures			
B.	For Each Unit Process, Specific Coverage of the Following:			
1.	Normal operation (valve positions, sludge depths, etc.)			

	YES	NO	NA
2. Alternate operation modes	___	___	___
3. Emergency operations/failsafe features	___	___	___
IV. PERSONNEL			
A. Staffing and Training Plan			
1. Supervision	___	___	___
2. Administration	___	___	___
3. Operation	___	___	___
4. Maintenance	___	___	___
5. Total personnel	___	___	___
6. Annual training	___	___	___
7. Laboratory training needs	___	___	___
B. Qualifications			
1. Training	___	___	___
2. Skills required	___	___	___
3. Experience	___	___	___
4. Certification required	___	___	___
C. Certification			
1. Copy of state rules and regulations	___	___	___
2. Certification requirements of facility	___	___	___
V. LABORATORY TESTING AND PROCESS CONTROL			
A. Outline of Sampling and Testing Program, Discussion of Purpose	___	___	___
B. Discussion of Laboratory Results, Expected Ranges, and Process Control Adjustments from Test Results	___	___	___
C. Provision of Sample Laboratory Worksheets, Instructions, and Test Results Forms	___	___	___

	YES	NO	NA
D. Recommended List of Laboratory References	____	____	____
E. Laboratory Equipment, Supplies, and Chemicals Inventory	____	____	____
F. Operating Cost Recordkeeping System Recommendations	____	____	____
G. Personnel Record System Recommendations	____	____	____
H. Emergency Conditions, Bypass Reports, Permit Violations, etc.	____	____	____
I. Maintenance and Laboratory, If Not Provided Elsewhere	____	____	____
VI. RECORDS			
A. General - Importance of Recordkeeping	____	____	____
B. Facility Construction Records	____	____	____
C. Sample of Daily Operating Log of Process, Operations, Instructions	____	____	____
D. Sample of Monthly Operating Report to State Agency and Instructions	____	____	____
E. Sample of Annual Report Format	____	____	____
F. Operating Cost Recordkeeping System Recommendations	____	____	____
G. Personnel Record System Recommendations	____	____	____
H. Emergency Conditions, Bypass Reports, Permit Violations, etc.	____	____	____
I. Maintenance and Laboratory, If Not Provided Elsewhere	____	____	____
VII. MAINTENANCE			
A. Conceptual Description of Maintenance Program	____	____	____
B. Equipment Record System			
1. Equipment numbering system			
2. Equipment catalog (configuration list)	____	____	____

		YES	NO	NA
3.	Maintenance record cards, instruction			
4.	Nameplate data cards, all major equipment			
5.	List of warrantied equipment, warranty provisions			
C.	Miscellaneous Maintenance Records			
D.	Planning and Scheduling			
1.	Normal preventive maintenance schedule provided			
2.	Lubrication schedule and lubricant list			
3.	Emergency, corrective maintenance			
4.	Work order system and sample form			
E.	Storeroom and Inventory System			
1.	Recommended list of spare parts			
2.	Procedures, stockroom inventory, sample forms, and records			
F.	Special Tool List and Toolroom Control			
G.	Maintenance Personnel Staffing Requirements			
H.	System for Cost Accounting and Budgeting			
I.	Recommended List of Outside Contract Maintenance Tasks and Firms			
VIII.	EMERGENCY OPERATING AND RESPONSE PLAN			
A.	Objectives			
B.	Vulnerability Analysis			
C.	Mutual Aid List			
D.	Emergency Equipment List			
E.	Records Preservation			
F.	List of Industrial Sources (Including Monitoring and Response System)			

G. Police/Fire Coordination ___ ___ ___

H. Personnel Assignment In Detail ___ ___ ___

I. Readiness/Emergency Response Center ___ ___ ___

J. Emergency Operating Plan ___ ___ ___

IX. SAFETY

A. Importance of Safety Program ___ ___ ___

B. Content

1. Emergency phone list ___ ___ ___
2. Safety equipment list ___ ___ ___
3. Sewer hazards ___ ___ ___
4. Electrical hazards ___ ___ ___
5. Mechanical equipment hazards ___ ___ ___
6. Explosion and fire hazards ___ ___ ___
7. Bacterial infection ___ ___ ___
8. Chlorine hazards ___ ___ ___
9. Oxygen deficiency/gases ___ ___ ___
10. Laboratory hazards ___ ___ ___
11. Process chemicals handling ___ ___ ___
12. List of references ___ ___ ___

C. Periodic Safety Program Review ___ ___ ___

D. Accident Report Form ___ ___ ___

X. UTILITIES

A. List of Utility Suppliers

1. Electrical ___ ___ ___
2. Telephone ___ ___ ___
3. Natural gas ___ ___ ___

			YES	NO	NA
		4. Water	___	___	___
		5. Fuel Oil	___	___	___
	B.	Capacities, Limitations, Responsibility Coordination	___	___	___
XI.	ELECTRICAL SYSTEM				
	A.	Power Source Description	___	___	___
	B.	Distribution System	___	___	___
	C.	Control and Monitoring System	___	___	___
	D.	Emergency Procedures	___	___	___
XII.	APPENDIX				
	A.	Schematics	___	___	___
	B.	Valve Indices	___	___	___
	C.	Sample Forms	___	___	___
	D.	Process Chemicals/Source	___	___	___
	E.	Detailed Design Criteria	___	___	___
	F.	Equipment Suppliers	___	___	___
	G.	Manufacturer's Manuals	___	___	___
	H.	Sources; Service and Parts	___	___	___
	I.	As-Built Drawings	___	___	___
	J.	Approved Shop Drawings	___	___	___
	K.	Dimension Prints	___	___	___
	L.	Construction Photos	___	___	___
	M.	Warranties and Bonds	___	___	___
	N.	State O&M Inspection Form	___	___	___
	O.	EPA Form 7500-5	___	___	___
	P.	Sewer Use Ordinance	___	___	___

Q.	Industrial; Ordinance/Control	___	___	___
R.	Pretreatment Controls/Ordinances	___	___	___
S.	Piping Color Code	___	___	___
T.	Protective Coating List	___	___	___
U.	Sewer Maintenance Program	___	___	___
V.	Map of Collection System and Lift Stations	___	___	___
W.	Recommended References	___	___	___

UNIT SIX

START-UP SERVICES AND INSPECTIONS

OUTLINE

I. USE OF O&M CHECKLISTS 6-2
II. START-UP SERVICES 6-4
    A. Planning, Use, and Needs
    B. Training
    C. Provider
    D. Funding and Eligibility: PRM 77-2
    E. Guarding Against Double Payment
    F. Summary
    G. Operation Review Checklist

OBJECTIVES

Following the Unit Six presentation, the participant will be able to:

1. Name and discuss specific O&M checkpoints
2. Use the appropriate checklist to monitor O&M compliance requirements
3. Evaluate start-up services and discuss their importance
4. Discuss the value of onsite locally controlled inspections

USE OF O&M CHECKLISTS

There are many O&M checkpoints throughout the three-step construction grants process. At each of these, the reviewing agency should conduct an O&M review using the appropriate checklist. A list of these checkpoints and checklists follows:

1. Preapplication Conference, O&M Considerations for Discussion: This conference is used to introduce the entire grants process and to emphasize grantee responsibilities for quality operation and maintenance.

2. Plan of Study, Operation Review Checklist: This checklist is used to determine the applicant's knowledge and understanding of all applicable rules and regulations including O&M requirements.

3. Facilities Plan, Operation Review Checklist: This checklist is used to determine 1) that the applicant has evaluated all alternatives (including upgrading O&M at the existing facility) in selecting the plan, and 2) that O&M concerns have been adequately considered by the applicant.

4. Application Step 2, Operation Review Checklist: This checklist is used to determine if the applicant is complying or will comply with O&M requirements.

5. Predesign Conference, O&M Considerations for Discussion: This conference is held to emphasize O&M considerations in the design process.

6. Plans and Specifications, Operation Review Checklist: This checklist is used to conduct an operational review of the plans and specifications including such O&M requirements as design, flexibility, operability and maintainability, unit and component reliability, documentation of expected flows and loads, safety, and compliance.

7. Plan of Operation, Review Checklist: This checkpoint was covered in Unit 4.

8. Preconstruction Conference, O&M Considerations for Discussion Checklist: This checkpoint was covered in Unit 2.

9. Application Step 3, Operation Review Checklist: This checklist helps to determine if the applicant has complied or will comply with O&M requirements covered at the preconstruction conference.

10. O&M Manual Quality Evaluation Report and Operation Review Checklist: This checkpoint evaluates the O&M manual to determine if it contains the necessary information on facility operation and maintenance. The checklist is presented in a form that is readable and usable.

11. Start-Up Services Operation Review Checklist: In-depth coverage of this checkpoint will be presented in this unit.

12. Interim and Final Construction Inspection, Operation Review Checklist: These inspections are held to ensure that the facility is constructed according to approved plans and specifications and that all O&M requirements have been fulfilled.

The reviewer should use an O&M review checklist at each checkpoint when conducting an O&M review. The grantee should receive a copy of each checklist used and comments made by the reviewer. This will aid the grantee in knowing how well the O&M requirements are being met. The grantee may then use the checklists as a means of monitoring the consultant's activities.

START-UP SERVICES

Planning, Use, and Needs

The construction grants program provides funding for the planning, design, and construction of wastewater treatment plants. The primary function of these wastewater treatment plants is to collect and treat wastewater to obtain specific conditions and limitations on the discharged effluent. The wastewater treatment facility must begin the effective treatment of wastewater from the first day of operation in order to meet these required conditions and limitations. The key to providing effective wastewater treatment is successful plant start-up.

Start-up does not just happen. It requires months of preparation. Step-by-step start-up procedures must be developed. All operating and maintenance personnel should be hired well in advance of start-up (six months is recommended). Classroom and field training on specific plant systems and components must be held. O&M procedures must be completed and explained. All manufacturer's equipment training programs should be completed. The maintenance management system must be complete and functional. All of these must be accomplished to assure an effective plant start-up.

Start-up may be defined as a series of events that lead to a stabilized routinely controlled unit process or plant. This includes prestart-up preparation, start-up of primary (if any) and secondary treatment units, chlorination facilities, laboratory procedures, sludge handling process and units, post-start-up training, and O&M manual revision and update.

Start-up of any wastewater treatment facility is a complex operation. It requires careful planning, effective coordination, and detailed preparation to maximize the treatment plant's efficiency and minimize problems. The information contained in the start-up proposal should provide operation and maintenance personnel with the guidelines necessary to inspect and adjust all equipment prior to start-up. The start-up services should outline all steps for placing treatment units or processes in operation. It should also provide information on monitoring and controlling the unit and/or process until treatment objectives are met. The start-up proposal should also state what should be done to continue meeting treatment objectives.

Information contained in a start-up proposal should be tailored to meet the needs of the specific plant. The proposal for a 1 MGD activated sludge plant would be different from that of a 20 MGD activated sludge plant. Careful consideration should be given to a start-up service proposal to ensure that no important activities are overlooked.

Start-up services will help assure that the wastewater treatment facility achieves operational objectives quickly and effectively. Successful plant start-up will assure that:

1. Design operational efficiency is achieved as quickly as possible
2. Control and related equipment problems are identified and resolved
3. Onsite personnel instruction is provided on process details and equipment in each particular plant
4. Final revision of the O&M manual is made based upon actual operating experience

These goals can be met with a carefully planned and properly implemented start-up service plan.

Adequate consideration of plant start-up is essential 1) to assure a minimum of problems in plant operation and 2) to set the proper framework for long term, trouble-free, efficient plant operation under all conditions.

In addition to assuring effective plant start-up, these services are important because they pull the entire O&M program together before the closing out of Step 3 grants. Start-up services will ensure that the plan of operation has been implemented. The plan of operation identifies specific actions and related completion dates to assure that the wastewater treatment facility and all associated personnel are properly prepared for start-up and continued operation. A basic relationship exists between start-up services and the plan of operation. One is the plan, while the other is the tool for implementing the plan.

Start-up is the key to efficient operation and maintenance. This provides the means for tying together the O&M manual and the plan of operation. The O&M manual provides detailed procedures for start-up. The plan of operation identifies specific actions and dates for start-up and continued operation. Start-up services provide the means for implementing the plan of operation through the use of information provided in the O&M manual.

O&M
PLAN OF OPERATIONS

This relationship provides an opportunity for all personnel associated with the O&M program (engineer, regulatory agency, plant personnel, owners, equipment suppliers, etc.) to evaluate and correct (if needed) the entire O&M program for the wastewater treatment facility.

Start-up services are the designer's ultimate challenge. All phases of wastewater treatment must be brought into focus in a cost-effective and timely manner. The major goal of plant start-up is to achieve plant performance objectives quickly and efficiently. To accomplish this goal, start-up services must address the performance of plant staff and plant equipment.

ULTIMATE
CHALLANGE

Other issues that interact in achieving plant start-up objectives are a maintenance management program, plant management records system, laboratory support, process tuning, and the O&M manual.

Training

Basic training in the principles of wastewater treatement is the responsibility of the grantee and must be done prior to start-up. Start-up training instructs personnel with basic qualifications in wastewater treatement and provides them with plant specific instructions.

Start-up training involves a twofold process. First, plant personnel are provided with information on all processes, equipment, and instrumentation at the facility. The importance of process interaction and development of sound judgment and initiative is stressed. Staff training should produce strong supervisors, highly qualified staff, and a team approach to facility O&M.

Second, the designer learns from the plant's O&M staff ways to improve plant design, plans and specifications, start-up procedures, training, and the O&M manual. From the information obtained, the designer will be able to develop a more effective O&M program.

TRAINING
PROGRAM

The most important use of start-up services is as a training program. Meeting effluent performance requirements in a cost-effective and timely manner is the objective of plant start-up. Successful start-up of any wastewater treatment facility is a major task. It requires a training program that motivates plant personnel, coordinates plant equipment operation to plant process operation, and coordinates all other aspects of plant operation including:

1. Management
2. Maintenance scheduling
3. Laboratory controls
4. Use of O&M manuals

A brief review of the steps involved in start-up follows:

1. Hire personnel
2. Establish a maintenance management system and train personnel in its use
3. Establish laboratory procedures and train personnel in their use
4. Establish a records management system and train personnel in its use
5. Provide prestart-up training in
    a. plant operation
    b. plant maintenance
    c. plant supervision and management

6. Check equipment and instruments
7. Start system with hands-on training
8. Fine tune systems and instruments
9. Revise plant O&M manual
10. Prepare first annual report

Each of these steps involves some degree of training because of the working relationship between plant personnel and start-up service personnel.

Much of this training may be carried out by equipment suppliers and contractors. The quality of this training, however, is dependent upon the requirements contained in the plans and specifications. The design engineer must be specific in the type of service wanted. The specifications should require that the equipment supplier and/or contractor provide:

1. Mechanical start-up services
2. Process start-up services
3. Training of plant personnel

To obtain these services the designer should state what is required in terms of personnel and time. This training can go a long way in making the wastewater treatment facility function properly.

There are three basic elements in an effective training program:

1. Preparation
2. Delivery
3. Followup

Preparation should begin early in the design phase. At this time staffing estimates, start-up operating concepts, and construction scheduling are finalized. The preliminary plan of operation outlining start-up and training activities has been prepared. In addition, a draft of the O&M manual should be prepared.

During the construction phase, the final O&M manual and plan of operation are begun. A start-up training schedule must be coordinated with the O&M manual. The trend in start-ups has been toward a phased approach. As construction is completed, the start-up training is begun. The author of the O&M manual must develop those sections needed for use during start-up training.

The trainer should meet with the plant staff during the program preparation period to develop basic training outlines. He/she must become familiar with plant personnel and their backgrounds in order to target a training program that meets their needs. The training will also determine what type or style of delivery is needed. At this time, the plant's reference library may be developed and required items may be ordered. As these training programs are developed and refined, they will become part of the plant's O&M manual.

Program delivery is important. The instructor must have both training and technical expertise. The presentation should be short, informal, and easily understood by the participants. Participants should be involved and interact as much as possible. Although the training is normally onsite, offsite training may be approved when properly justified. The training should be a combination of classroom and hands-on training. A pure lecture approach is ineffective.

EXTRA EXTRA
NEWS

After the training program has been delivered, the start-up service trainer must implement a followup program. The importance of a followup program is seldom considered. Start-up services must provide more than well-trained staff and efficient operation. The turnover rate at most wastewater plants is very high. The shortage of well-trained, qualified operating personnel in the wastewater field is increasing. To help the plant deal with this problem, the start-up service provider must establish a followup system to provide the plant with an ongoing training program for new personnel. A training officer should be appointed to accept the responsibility for the training program. There should be some type of reward or incentive for new and old employees to increase their skills and knowledge in treating wastewater.

Start-up training is customized training provided by a consultant. For training to be effective, time and effort must be spent in preparation. The delivery must be appropriate to fit the needs of the plant and its staff. Training should be evaluated to determine if the expected learning outcomes were achieved. A followup program is a must to provide ongoing plant training. The benefits of a good start-up are tremendous. The plant that has a poor start-up program will pay the price for many years to come.

Provider

Who should perform the start-up services for the plant? The Program Requirements Memorandum (PRM 77-2) states: "To be grant eligible, the services must be rendered by the design engineer or others identified by the design engineer." This places the design engineer in the driver's seat to provide or direct start-up services. The design engineer does appear to be the most logical person to provide site-specific start-up services. The engineer designed the plant, is instrumental in developing the O&M manual and plan of operation, and is knowledgeable about the plant and its performance. It is also important that the engineer have training expertise equal to or exceeding his/her technical expertise. The engineer's knowledge of the plant and its performance objectives is of little use if it cannot be successfully communicated.

Having qualified personnel to coordinate start-up services is critical. The provider must have the expertise to utilize various professional training tools and must be able to respond to a variety of attitudes and educational conditions found at the treatment facility. The provider must have the resources to provide special manpower or technical support as needed.

Effective start-up depends upon technical knowledge and the ability to communicate. Without these the goal of meeting the objective effluent performance requirement in a cost-effective and timely manner will not be reached.

Funding and Eligibility: PRM 77-2

The Construction Grants Program Requirements Memorandum (PRM 77-2) identifies specific services rendered during the start-up period of a wastewater treatment facility that are eligible for grant funding. This PRM will assist the applicant in developing grant eligible start-up services. These services will help assure that wastewater treatment facilities achieve operational objectives rapidly and effectively. The grantee should understand the requirement listed in PRM 77-2 (see following pages).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CONSTRUCTION GRANTS PROGRAM REQUIREMENTS MEMORANDUM
PRM #77-2

DATE: November 29, 1976

SUBJECT: Grant Eligibility of Start-up Services

FROM: John T. Rhett, Deputy Assistant Administrator
for Water Program Operations (WH-546)

TO: Region Administrators I - X
ATTN: Water Division Directors

PURPOSE: The purpose of this memorandum is to identify specific services, rendered during the start-up period of a new treatment works, that are eligible for grant funding. Such services will help assure that municipal treatment works will achieve operational objectives more rapidly and effectively.

DISCUSSION: In response to a recognized need to place increased emphasis on the effective operation of new waste treatment facilities constructed with Federal grant funds, it has been determined that the cost of certain services provided during the plant start-up period shall be eligible for grant support. Such services are intended to assure that: design operational efficiency is achieved as quickly as possible; process control and related equipment problems are identified and resolved; onsite instruction to personnel in details of the process and equipment of each particular plant is provided; and final revisions to the O&M manual, based upon actual operating experience, are made.

POLICY: This PRM confirms eligibility for start-up services under the following terms and conditions. Start-up services for new wastewater treatment works constructed with contract authority funds are eligible for grant support in accordance with the following guidance.

Grant eligible start-up services will average 90 man-days for most treatment plants. For large or complex plants, however, grant eligible start-up service may range up to 300 man-days. Start-up services shall be completed within a period of twelve months. In addition to grant eligible start-up services, grantees, in most cases, should be encouraged to negotiate separate agreements for technical and training service to identify and solve operational problems beyond the initial start-up period. However, only that period of time which conforms with guidance provided herein will be eligible for grant assistance.

Grant eligible start-up services are limited to those items described below. (Other services proposed for grant eligibility will be considered only on a case-by-case basis by the Regional Administrator.) The extent of such services will depend on the size and complexity of the facility and the capabilities of existing or new operational and management staff. In many cases services to address the potential needs below may be coupled with other related services. To be grant eligible, the services must be rendered by the design engineer or others identified by the design engineer.

1. Pre and post start-up personnel training--i.e., onsite training given plant operation and maintenance personnel on the operation and control of the specific treatment processes of the facility as well as specialized training required for the safe operation and maintenance of plant equipment.

It could also include consultation on the staffing and training plan before completion of construction. Such consultation would be supplemental to the O&M manual and intended to give plant personnel a clear understanding of individualized operation and management responsibilities. Grant eligible training and related consultation are not to be a substitute for routine, entry-level or update operator training, the funding of which is the responsibility of the grantee.

2. Fine tuning to optimize process control--i.e., expert operational assistance for adjustment and "fine tuning" of the treatment processes and related equipment functions to optimize performance, safety and reliability under actual operating conditions. This should include the detailing of operational procedures under both normal and abnormal conditions so as to achieve consistent, reliable, and efficient performance from each process component at all times.

3. Laboratory procedures--i.e., onsite training and instruction to assure that the sampling and laboratory testing program needed for satisfactory process control and regulatory monitoring and reporting are fully understood. Entry-level or update training in basic laboratory testing and procedures for routine analyses are not grant eligible, although training in unique testing requirements related to some unusual unit process or process equipment may be determined to be grant eligible.

4. Maintenance management system--i.e., start-up services to assure effective implementation of the maintenance management system outlined in the facility's O&M manual. Included is training of the operation and maintenance staff in the details of the maintenance management system to establish and maintain a preventive maintenance program.

5. Records management systems--i.e., services to provide the training needed to implement a records management system as outlined in the O&M manual. It will become a major element in the larger and more complex plants that require a refined system to adequately handle records related to process control, effluent quality monitoring and reporting requirements, inventories for chemicals, supplies, spare parts, etc.

6. Revise O&M manual--i.e., revising the O&M manual based upon actual operating experience obtained during the start-up period. It is not intended to replace the present requirements for drafting and finalizing the O&M manual before plant start-up, but does recognize that some aspects of plant operation and process control can be documented more fully after a period of actual plant operation.

Note that costs normally associated with the operation and maintenance of a municipal wastewater treatment facility, such as salaries for operation and maintenance personnel, chemicals (except for the basic inventory required for start-up), power, etc., are not eligible. Also ineligible are the costs of all off-site formal training/orientation programs. Finally, wet and dry equipment and facility testing is the responsibility of the contractor under the supervision of the Engineer.

IMPLEMENTATION: Start-up service provisions should normally be submitted as part of Step 3 grant, and State agencies and potential Step 3 grantees should be encouraged to consider the development of appropriate provisions as soon as possible. For existing Step 3 projects that have not begun actual plant operations, grantees should be encouraged, where timing permits, to develop start-up service provisions prior to plant start-up. Under exceptional circumstances, consideration may be given to eligibility of start-up services for grant funded projects that have already begun operation but for which the Step 3 grant has not been closed out. However, reimbursement should not be made for start-up services completed prior to the effective date of the PRM unless specifically described in existing contract documents.

Start-up service participation is optional. If grant participation is desired, then the following steps must be taken:

1. The design engineer must submit a proposal. Proposals for start-up services will be submitted with the Step 3 grant application.

2. The design engineer will provide all services or certify a sub-contractor who is qualified to provide the service.

3. The start-up services should be under the supervision of a certified operator at the level of certification which is required of the operator of that treatment facility.

4. Start-up service proposals will be approved and certified by the state agency before being forwarded to EPA for approval.

5. The proposal will contain a statement of requested service, a course curriculum or training outline, names of persons providing services and their operational and training qualifications, and the number of days needed to accomplish each task.

6. The proposal will contain a cost breakdown of the services requested.

7. Start-up services will be completed within a period not to exceed 12 months from the time the plan commences actual operation treating domestic sewage. If prestart-up personnel training is required, the period, not to exceed 12 months, will commence at the time this training begins.

Guarding Against Double Payment

The grantee must take measures to prevent double payment. Activities included in the plan of operation, O&M manual preparation and revision, and start-up services are similar and sometimes identical. All of the costs associated with these three should be listed as separate line items. The grantee will be able to compare the three line items in order to avoid duplicate services and prevent double payment.

Summary

Start-up services provide the means to achieve the goal of meeting effluent limitations in a cost-effective and timely manner. These services must be tailored to a specific plant and the needs of its staff. Personnel providing the start-up services must have:

1. Technical expertise
2. Training expertise
3. An operations background
4. Resources to call upon for additional manpower or technical support

Plant performance will suffer greatly if the grantee does not participate in start-up services. The long term benefits of participation in a good start-up program far outweigh any additional effort and costs the grantee may incur. The lack of a good start-up program will cost the grantee for many years to come.

PROPER TRAINING AND START-UP PROCEDURES...
...WILL PREVENT PROBLEMS!

Operation Review Checklist

The following checklist is used by the reviewer to conduct an O&M review of start-up services. The checklist can also be used by the grantee to monitor consultant activities and determine how well O&M requirements are being met.

START-UP SERVICES

OPERATION REVIEW CHECKLIST

			YES	NO	NA
1.	Did the Step 2 grant application include a commitment to prepare start-up provisions?		___	___	___
2.	Did the Step 3 grant application include clearly defined start-up provisions in a cohesive proposal?		___	___	___
3.	Do proposed start-up services include:				
	a.	Pre- and poststart-up personnel training, including onsite training?	___	___	___
	b.	Fine tuning to optimize process control?	___	___	___
	c.	Laboratory management training?	___	___	___
	d.	Maintenance management training?	___	___	___
	e.	Records management training?	___	___	___
	f.	O&M manual revision?	___	___	___
4.	a.	Will start-up services be accomplished within 12 months after start-up?	___	___	___
	b.	How many man-days are required to accomplish proposed start-up services? ______________ days.			
5.	Is start-up presented as a separate line item?		___	___	___
6.	Is the start-up service provider qualified?		___	___	___
7.	Do proposed start-up services assure:				
	a	Design operational efficiency will be achieved quickly?	___	___	___
	b.	Process control problems and related equipment problems are identified and resolved?	___	___	___
	c.	Onsite instruction to personnel in the details of process and equipment of plant will be provided?	___	___	___
	d.	Revisions to O&M manual will be based upon actual operating experience?	___	___	___
8.	Summary				

APPENDIX

REGULATIONS

1.	40 CFR 35.925-10	Operation and Maintenance Program
2.	40 CFR 35.935-1	Grantee Responsibilities
3.	40 CFR 35.935-12	Operation and Maintenance
4.	40 CFR 35.965	Enforcement

40 CFR 35.925-10

OPERATION AND MAINTENANCE PROGRAM

If the award of a grant assistance is for a Step 3 project, that the applicant has made satisfactory provision to assure proper and efficient operation and maintenance of the treatment works (including sewer system) in accordance with 35.935-12 and that the State will have an effective operation and maintenance monitoring program to assure that treatment works assisted under this subpart comply with applicable permit and grant conditions.

40 CFR 35.935-1

GRANTEE RESPONSIBILITIES

(a) Review or approval of project plans and specifications by or for EPA is for administrative purposes only and does not relieve the grantee of its responsibility to design, construct, operate, and maintain the treatment works described in the grant application and agreement.

(b) By its acceptance of the grant, the grantee agrees to complete the treatment works in accordance with the facilities plan, plans and specifications, and related grant documents approved by the Regional Administrator, and to maintain and operate the treatment works to meet the enforceable requirements of the Act for the design life of the treatment works. The Regional Administrator is authorized to seek specific enforcement or recovery of funds from the grantee, or to take other appropriate action (see 40 CFR 35.965), if he determines that the grantee has failed to make good faith efforts to meet its obligations under the grant.

(c) The grantee agrees to pay, pursuant to section 204(a)(4) of the Act, the non-Federal costs of treatment works construction associated with the project and commits itself to complete the construction of the operable treatment works and complete waste treatment system (see definitions in 40 CFR 35.905) of which the project is a part.

(d) The Regional Administrator may include special conditions in the grant or administer this subpart in the manner which he determines most appropriate to coordinate with, restate, to enforce NPDES permit terms and schedules.

40 CFR 35.935-12

OPERATION AND MAINTENANCE

(a) The grantee must make provision satisfactory to the Regional Administrator for assuring economic and effective operation and maintenance of the treatment works in accordance with a plan of operation approved by the state water pollution control agency or, as appropriate, the interstate agency.

(b) As a minimum, the plan shall include provisions for:

1. An operation and maintenance manual for each facility;
2. An emergency operating and response program;
3. Properly trained management, operation, and maintenance personnel;
4. Adequate budget for operation and maintenance;
5. Operational reports;
6. Provisions for laboratory testing and monitoring adequate to determine influent and effluent characteristics and removal efficiencies as specified in the terms and conditions of the NPDES permit.
7. An operation and maintenance program for the sewer system.

(c) Except as provided in paragraphs (d) and (e) of this section, the Regional Administrator shall not pay:

1. More than 50 percent of the Federal share on any Step 3 project unless the grantee has furnished a draft of the operation and maintenance manual for review, or adequate evidence of timely development of such a draft; or
2. More than 90 percent of the Federal share unless the grantee has furnished a satisfactory final operation and maintenance manual.

(d) In projects where segmenting of an operable treatment works has occurred, the Regional Administrator shall not pay:

1. More than 50 percent of the Federal share of the total of all interdependent Step 3 segments unless the grantee has furnished a draft of the operation and maintenance manual for review, or adequate evidence of timely development of such a draft, or

2. More than 90 percent of the Federal share of the total of all interdependent Step 3 segments unless the grantee has furnished a satisfactory final operation and maintenance manual.

(e) In multiple facility projects where an element or elements of the treatment works are operable components and have been completely constructed and placed in operation by the grantee, the Regional Administrator shall not make any additional Step 3 payment unless the operation and maintenance manual (or those portions associated with the operating elements of the treatment works) submitted by the grantee has been approved by the Regional Administrator.

40 CFR 35.965
ENFORCEMENT

If the Regional Administrator determines that the grantee has failed to comply with any provision of this subpart, he may impose any of the following sanctions:

(a) The grant may be terminated or annulled under 30.920 of this subchapter;

(b) Project costs directly related to the noncompliance may be disallowed;

(c) Payment otherwise due to the grantee of up to 10 percent may be withheld (see 30.615-3 of this chapter);

(d) Project work may be suspended under 30.915 of this subchapter;

(e) A noncomplying grantee may be found nonresponsible or ineligible for future Federal assistance or a noncomplying contractor may be found nonresponsible or ineligible for approval for future contract award under EPA grants;

(f) An injunction may be entered or other equitable relief afforded by a court of appropriate jurisdiction;

(g) Such other administrative or judicial action may be instituted if it is legally available and appropriate.

GLOSSARY OF TERMS

1. "Act." The Clean Water Act (33 U.S.C. 1251 et seq., as amended).

2. "Ad valorem tax." A tax based upon the value of real property.

3. "Combined sewer." A sewer intended to serve as a sanitary sewer and a storm sewer, or as an industrial sewer and a storm sewer.

4. "Complete waste treatment system." A complete waste treatment system consists of all the treatment works necessary to meet the requirements of title III of the Act, involved in: (a) The transport of waste waters from individual homes or buildings to a plant or facility where treatment of the wastewater is accomplished; (b) the treatment of the wastewaters to remove pollutants; and (c) the ultimate disposal, including recycling or reuse, or the treated wastewaters and residues which result from the treatment process. One complete waste treatment system would, normally, include one treatment plant or facility, but also includes two or more connected or integrated treatment plants or facilities.

5. "Construction." Any one or more of the following: Preliminary planning to determine the feasibility of treatment works, engineering, architectural, legal, fiscal, or economic investigations or studies, surveys, designs, plans, working drawings, specifications, procedures, or other necessary actions, erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works, or the inspection or supervision of any of the foregoing items. The phrase "initiation of construction," as used in this subpart means with reference to a project for:
   (a) Step 1: The approval of a plan of study
   (b) Step 2: The award of a step 2 grant;
   (c) Step 3: Issuance of a notice to proceed under a construction contract for any segment of step 3 project work or, if notice to proceed is not required, execution of the construction contract.

6. "Contractor." A party to whom a subagreement is awarded.

7. "Enforceable requirement of the Act." Those conditions or limitations of section 402 or 404 permits which, if violated, could result in the issuance of a compliance order or initiation of a civil or criminal action under section 309 of the Act. If a permit has not been issued, the term shall include any requirement which in the Regional Administrator's judgment, would be included in the permit when issued. Where no permit applies, the term shall include any requirement which the Regional Administrator determines is necessary to meet applicable criteria for best practicable waste treatment technology (BPWTT).

8. "Excessive infiltration/inflow." The quantities of infiltration/inflow which can be economically eliminated from a sewerage system by rehabilitation, as determined in a cost-effectiveness analysis that compares the costs for correcting the infiltration/inflow conditions to the total costs for transportation and treatment of the infiltration/inflow, subject to the provisions in 35.927.

9. "Grant agreement." The written agreement and amendments thereto between EPA and a grantee in which the terms and conditions governing the grant are stated and agreed to by both parties under 30.345 of this subchapter.

10. "Grantee." Any municipality which has been awarded a grant for construction of a treatment works under this subpart. In addition, where appropriate in 35.936 through 35.939, grantee may also refer to an applicant for a grant.

11. "Industrial cost recovery." (a) The grantee's recovery from the industrial users of a treatment works of the grant amount allocable to the treatment of waste from such users under section 204(b) of the Act and this subpart.

    (b) The grantee's recovery from the commercial users of an individual system of the grant amount allocable to the treatment of waste from such users under section 201(h) of the Act and this subpart.

12. "Industrial cost recovery period." That period during which the grant amount allocable to the treatment of wastes from industrial users is recovered from the industrial users of such works.

13. "Industrial user." (a) Any nongovernmental, nonresidential user of a publicly owned treatment works which discharges more than the equivalent of 25,000 gallons per day (gpd) of sanitary wastes and which is identified in the Standard Industrial Classification Manual, 1972, Office of Management and Budget, as amended and supplemented.

    (b) Any nongovernmental user of a publicly owned treatment works which discharges wastewater to the treatment works which contains toxic pollutants or poisonous solids, liquids, or gases in sufficient quantity either singly or by interaction with other wastes, to contaminate the sludge of any municipal systems, or to injure or to interfere with any sewage treatment process, or which constitutes a hazard to humans or animals, creates a public nuisance, or creates any hazard in or has an adverse effect on the waters receiving any discharge from treatment works.

    (c) All commercial users of an individual system constructed with grant assistance under section 201(h) of the Act and this subpart.

14. "Infiltration." Water other than wastewater that enters a sewerage system (including sewer service connections) from the ground through such means as defective pipes, pipe joints, connections, or manholes. Infiltration does not include, and is distinguished from, inflow.

15. "Infiltration/inflow." The total quantity of water from both infiltration and inflow without distinguishing the source.

16. "Inflow." Water other than wastewater that enters a sewerage system (including sewer service connections) from sources such as roof leaders, cellar drains, yard drains, area drains, foundation drains, drains from springs and swampy areas, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, storm waters, surface runoff, street wash waters, or drainage. Inflow does not include, and is distinguished from, infiltration.

17. "Interceptor sewer." A sewer whose primary purpose is to transport wastewater from collector sewers to a treatment facility.

18. "Interstate agency." An agency of two or more States established under an agreement or compact approved by the Congress, or any other agency of two or more States, having substantial powers or duties pertaining to the control of water pollution.

19. "Municipality." A city, town, borough, county, parish, district, association, or other public body (including an intermunicipal agency of two or more of the foregoing entities) created under State law, or an Indian tribe or an authorized Indian tribal organization, having jurisdiction over disposal of sewage, industrial wastes, or other waste, or a designated and approved management agency under section 208 of the Act.

    (a) This definition includes a special district created under State law such as a water district, sewer district, sanitary district, utility district, drainage district, or similar entity or an integrated waste management facility, as defined in section 201(e) of the Act, which has as one of its principal responsibilities the treatment, transport, or disposal of liquid wastes of the genral public in a particular geographic area.

    (b) This definition excludes the following:

        (1) Any revenue producing entity which has as its principal responsibility an activity other than providing wastewater treatment services to the general public, such as an airport, turnpike, port facility, or other municipal utility.

        (2) Any special district (such as school district or a park district) which has the responsibility to provide wastewater treatment services in support of its principal activity at specific facilities, unless the special district has the responsibility under State law to provide waste water treatment services to the community surrounding the special district's facility and no other municipality, with concurrent jurisdiction to serve the community, serves or intends to serve the special district's facility or the surrounding community.

20. "Operable treatment works." An operable treatment works is a treatment works that:

(a) Upon completion of construction will treat waste water, transport waste water to or from treatment, or transport and dispose of waste water in a manner which will significantly improve an objectionable water quality situation or health hazard, and

(b) Is a component part of a complete waste treatment system which, upon completion of construction for the complete waste treatment system (or completion of construction of other treatment works in the system in accordance with a schedule approved by the Regional Administrator) will comply with all applicable statutory and regulatory requirements.

21. "Project." The scope of work for which a grant or grant amendment is awarded under this subpart. The scope of work is defined as step 1, step 2, or step 3 of treatment works construction or segments (see definition of "treatment works segment".

22. "Replacement." Expenditures for obtaining and installing equipment, accessories, or appurtenances which are necessary during the useful life of the treatment works to maintain the capacity and performance for which such works were deisgned and constructed. The term "operation and maintenance" includes replacement.

23. "Sanitary sewer." A sewer intended to carry only sanitary or sanitary and industrial waste waters from residences, commercial buildings, industrial plants, and institutions.

24. "Sewage collection system." Each, and all, of the common lateral sewers, within a publicly owned treatment system, which are primarily installed to receive waste waters directly from facilities which convey waste water from individual structures or from private property, and which include service connection "Y" fittings designed for connection with those facilities. The facilities which convey waste water from individual structures, from private property to the public lateral sewer, or its equivalent, are specifically excluded from the definition, with the

exception of pumping units, and pressurized lines, for individual structures or groups of structures when such units are cost effective and are owned and maintained by the grantee.

25. "State." A State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Trust Territory of the Pacific Islands, and the Commonwealth of the Northern Marianas.

26. "State agency." The State water pollution control agency designated by the Governor have responsibility for enforcing State laws relating to the abatement of pollution.

27. "Storm sewer." A sewer intended to carry only storm waters, surface runoff, street wash waters, and drainage.

28. "Subagreement." A written agreement between an EPA grantee and another party (other than another public agency) and any tier of agreement thereunder for the furnishing of services, supplies, or equipment necessary to complete the project for which a grant was awarded, including contracts and subcontracts for personal and professional services, agreements with consultants and purchase orders, but excluding employment agreements subject to State or local personnel systems. (See 35.937-12 and 35.938-9 regarding subcontracts of any tier under prime contracts for architectural or engineering services or construction awarded by the grantee - generally applicable only to subcontracts in excess of $10,000.)

29. "Treatment works." Any devices and systems for the storage, treatment, recycling, and reclamation of municipal sewage, domestic sewage, or liquid industrial wastes used to implement section 201 of the Act, or necesssary to recycle or reuse water at the most economical cost over the useful life of the works. These include intercepting sewers, outfall sewers, sewage collection systems, individual systems, pumping, power, and other equipment and their appurtenances; extensions, improvement, remodeling, additions, and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and

clear well facilities; and any works, including site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment (including land for composting sludge, temporary storage of such compost, and land used for the storage of treated wastewater in land treatment sytems before land application); or any other method or system for preventing, abating, reducing, storing, treating, separating, or disposing of municipal waste or industrial waste, including waste in combined storm water and sanitary sewer system.

30. "Treatment works segment." A treatment works segment may be any portion of an operable treatment works described in an approved facilities plan, which can be identified as a contract or discrete subitem or subcontract for step 1, 2, or 3 work. Completion of construction of a treatment works segment may, but need not, result in an operable treatment works.

31. "Useful life." Estimated period during which a treatment works will be operated.

32. "User charge." A charge levied on users of a treatment works, or that portion of the ad valorem taxes paid by a user, for the user's proportionate share of the cost of operation and maintenance (including replacement of such works under section 204(b)(1)(A) and 201(h)(2) of the Act and this subpart.

33. "Value engineering (VE)." A specialized cost control technique which uses a systematic and creative approach to identify and to focus on unnecessarily high cost in a project in order to arrive at a cost saving without sacrificing the reliability or efficiency of the project.

REFERENCES

(Used in handbook development)

References 1 - 11 are available from:

General Services Administration
Centralized Mailing Lists Services
Building 41, Denver Federal Center
Denver, Colorado 80225

1. Municipal Wastewater Management Citizen's Guide to Facility Planning FRD-6
2. Municipal Wastewater Management Public Involvement Activities Guide FRD-7
3. How to Obtain Federal Grants to Build Municipal Wastewater Treatment Works MCD-04 May 1976
4. Guidance for Preparing a Facility Plan MCD-46 May 1975
5. Construction Grants Program for Municipal Wastewater Treatment Facilities: Handbook of Procedures MCD-03 February 1976
6. Model Plan of Study: Supplement to Guidance for Preparing a Facility Plan EPA 430/9-6-004 March 1976 MCD-24
7. Consideration for Preparation of Operation and Maintenance Manuals USEPA 430/9-74-001
8. Federal Guidelines: Operation and Maintenance of Wastewater Treatment Facilities August 1974
9. Federal Guidelines: Design of Wastewater Treatment Facilities February 1976
10. NPDES Compliance Sampling Inspection Manual USEPA 1979 MCD-51
11. NPDES Compliance Sampling Inspection Manual October 1979 MCD-52
12. Federal Register, Wednesday, September 27, 1978, Part III, Environmental Protection Agency (available from Regional Office of USEPA)

USEFUL REFERENCES

Although these references were not used in developing this manual, much of the information contained can be very helpful to those involved in the construction grants process.

Available from:

General Services Administration
Centralized Mailing Lists Services
Building 41, Denver Federal Center
Denver, Colorado 80225

1. Aspects of State-Wide Emergency Response Programs for Municipal Wastewater Treatment Facilities MO 10
2. Aerobic Biological Wastewater Treatment Facilities, Process Control Manual MO 14
3. Anaerobic Sludge Digestion, Operations Manual MO 11
4. Emergency Planning for Municipal Wastewater Treatment Facilities MO 9
5. Estimating Laboratory Needs for Municipal Wastewater Treatment Facilities MO 6
6. Estimating Staffing for Municipal Wastewater Treatment Facilities MO 1
7. Maintenance Management Systems for Municipal Wastewater Facilities MO 7
8. Package Treatment Plants, Operations Manual MO 12
9. Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities, Field Manual MO 16
10. Sludge Handling and Conditioning, Operations Manual MO 13
11. Stabilization Ponds, Operations Manual MO 15
12. Start-Up of Municipal Wastewater Treatment Facilities MO 8